Knowledge & Scientific News

A MONTHLY JOURNAL OF SCIENCE.

Conducted by MAJOR B. BADEN-POWELL, F.R.A.S., F.R.Met.Soc., and E. S. GREW, M.A.

VOL. IV. No. 8. [NEW SERIES.] AUGUST, 1907. [Entered at Stationers' Hall.] SIXPENCE NET.

CONTENTS.—See page VII.

The "Highways" and the "Waterways" of Mars.

By MRS. WALTER MAUNDER.

THE present opposition of Mars affords no good opportunity for its study by *English* astronomers. But this is not in the least because the planet is modestly hiding his blushing face under any cloud veil. It is simply because he rises so little over our horizon that we have to observe him through a great thickness of our atmosphere. Astronomers in the southern hemisphere have Mars high in their sky, look at him through shallower atmosphere, and for them the opposition is a favourable one. A few thousand feet less or more of our atmosphere makes all the difference as to whether markings on Mars' surface can be seen or not.

And yet atmosphere is more easily seen out of than into, at least when it is sunlit. At the June meeting of the Royal Astronomical Society in 1898, the Rev. J. M. Bacon showed on the screen two photographs, taken by the same camera, one of the landscape from the ground, the other almost immediately afterwards from the car of a balloon leaving the earth. The first was perfectly sharp, but in the second everything was glared; the explanation doubtless being that particles in suspension in the air had their sunlit surfaces towards the camera, and the light thus scattered rendered the picture hazy and ill-defined.

We observe Mars not only through our atmosphere, but through his; we *look out* through our atmosphere, we *look down* through his. In Mr. Bacon's photograph, a few feet of illuminated particles were sufficient to glare the picture; when we observe the surface of Mars, we look through many miles of his atmosphere whose particles present their sunlit surfaces fully to us.

And yet we are able to study the surface of Mars. We can watch each snow-like polar cap diminish as that Martian hemisphere approaches its summer solstice; we can map out the forms of the grey-green regions and differentiate them from the orange and yellow regions. These are easy and we have been able to map them ever since the days of quite small and imperfect telescopes. But more than this, the more perfect telescopes and the unremitting study of the last quarter of a century have revealed the presence of an extremely complex structure on the surface of Mars, a structure whose geometric arrangement and definedness seems to leave no room for the haziness and indefiniteness which we have seen should be produced by the scattering of light by the particles of the Martian atmosphere.

Since we see and define the markings on the surface of Mars at all, we must suppose that there are—comparatively speaking—very few particles in the Martian atmosphere to be sunlit; the Martian atmosphere must be very rare indeed, much rarer than our own. But Mars has an atmosphere, one so considerable that it can contain a very appreciable amount of water vapour. Observing the spectrum of the planet on February 14, 1867, Sir William Huggins detected traces of some of the telluric bands due to water vapour, and though the observation is a very delicate one, and one may be readily deceived in the matter, there is little doubt as to its accuracy. Since the characteristic of definedness in the canal system is not compatible with our observing it through any appreciable amount of sunlit Martian atmosphere, we must conclude that no system on the actual surface of Mars produces this characteristic, but that this latter is produced by some cause outside the Martian atmosphere.

In this connection it may be interesting to recall a note, written in the issue of "KNOWLEDGE," for April 14, 1882, by the then Editor, the late Richard A. Proctor. Mr. Proctor commenting on a letter to the *Times* by Mr. Webb, on Schiaparelli's recently published discovery of the Martian "canals," wrote:—

> "I have thirty or forty drawings of views of Mars taken several years ago by Mr. Dawes—'eagle-eyed Dawes' as he was aptly named—in which, though he used but an 8-inch telescope, some of the narrow passages mentioned by Mr. Webb are shown. I mention this, because it may serve to corroborate what otherwise might seem improbable, the circumstance that Signor Schiaparelli should have seen with his comparatively small telescope what has escaped the attention of observers using such instruments as the Herschelian reflectors, the three-foot reflector made by Mr. Common, and the magnificent 26-inch refractor of Washington. Albeit, until observers with such instruments as these have distinctly seen what Signor Schiaparelli has mapped, we must not too hastily assume that these are real features of Mars. Mr. Nathaniel Green, whose fine lithographs of Mars adorn a recent volume of the Memoirs of the Astronomical Society, considers that these narrow passages are due to an optical illusion which he has himself experienced.
>
> "Should it be proved that the net-work of dark streaks has a real existence, we should by no means be forced to believe that Mars is a planet unlike our earth, but we might, perhaps, infer that engineering works on a much greater scale than any which exist on our globe have been carried on upon the surface of Mars. The smaller force of Martian gravity would suggest that such works would be conducted much more easily there than here, as I have elsewhere shown. It would be rash, however, at present to speculate in this way."

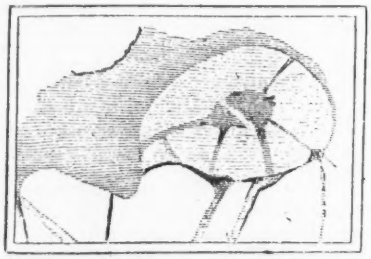
"Knowledge comes but Wisdom lingers." A quarter of a century after these words were penned, there are still to be found those who thus rashly speculate, those

who urge that because the network of lines, as they see it, appears sharply defined, therefore it betokens some stupendous engineering system. But if it be an engineering system, it cannot be on the surface of Mars, below the Martian atmosphere, for in that position it could not appear to us as defined. If sharply defined and truly Martian, it must therefore be an elevated system, built on the outer boundaries of the Martian envelope, a system of aerial railways or aerial waterways. If we place due weight on the small force of gravity on Mars, the suggestion is not much more absurd than the one that it is really an artificial canal system on the planet's surface. It would present no greater observational difficulties, and the combined effects of parallax and of shadow might explain the phenomena of duplication and of displacement of some of the canals.

At the opposition of 1894, Mr. A. E. Douglass observed the planet with Mr. Lowell's telescope at his observatory in Arizona, and he then made the "discovery of a whole system of canals in the dark regions, parallelling the system in the bright areas—being similarly straight and similarly intersecting one another, with spots at the intersections, making what Mr. Douglass aptly terms a checkerboard effect." These canals in the dark regions have been amply confirmed by subsequent observers. Thus in the Report for the opposition 1898-1899, of the Mars Section of the British Astronomical Association, Captain Molesworth writes (Memoirs of the British Astronomical Association, Vol. IX., Part III., pages 71): "I have been fortunate enough to trace several of Lowell's canals traversing the *Maria*. These features appear to me in prolongation of, and are obviously connected with, the true canals." If the *Maria* are not true seas, but marshy ground and therefore more abundantly covered with vegetation, we should be led to expect such prolongation of the artificial canal system over the dark regions, whether this system was aerial or on the surface.

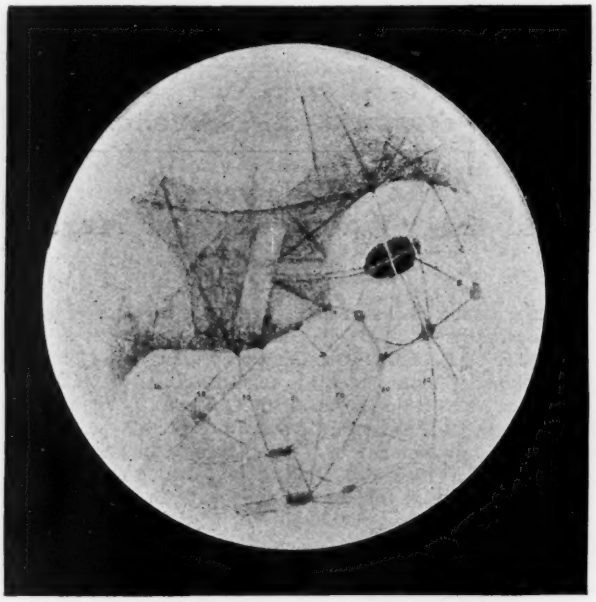
But there is a third and allied phenomenon which cannot be plausibly explained on either of these hypotheses.

Schiaparelli drew the "Eye" of Mars on June 9, 1890, and besides the numerous canals radiating off from the Solis Lacus in all directions, he showed the lake itself as crossed by a "bridge" some 500 miles long, and, perhaps, 50 wide. This is not a unique observation, for on October 28, 1894, between the hours of 7h.



The "Eye" of Mars, as drawn by Schiaparelli, June 9, 1890. (*From Flammarion's "Mars."*)

35m. and 7h. 50m., Mr. A. Stanley Williams reports (Memoirs of the British Astronomical Association, Vol. IV., Part IV., page 127) that once the Solis Lacus "appeared double, or divided into two by a light streak running from n.p. to s.f., and making an angle of about 45° with a meridian line through the centre of the lake. Owing to cloud it was impossible to confirm this." In his book "Mars," published in 1896, page 99, Mr. Lowell describes the Solis Lacus as a "great oval patch, measuring along its longest diameter five hundred and forty miles. With small telescopic power or in poor air it appears of uniform tint throughout, but under bet-



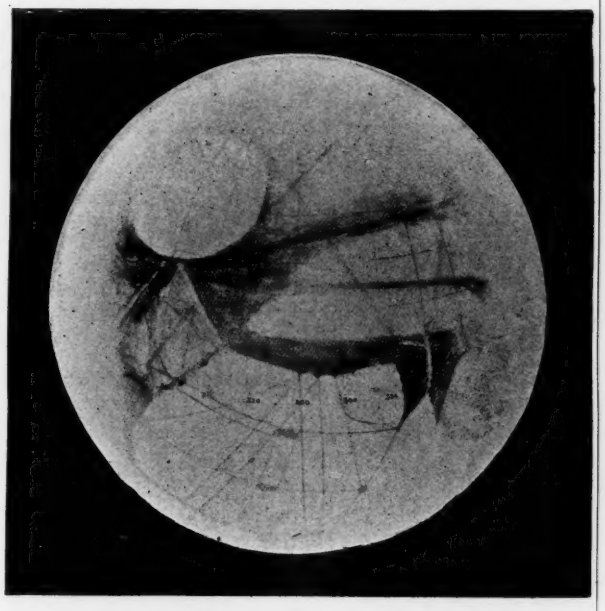
Longitude 60° on the Meridian. (*From Lowell's "Mars."*)

ter visual conditions dark spots appear in it, and bright causeways, which divide it into five portions." In the present year, in his circular, No. 28, Mr. Lowell again describes a "bridge" similar to that drawn by Sig. Schiaparelli, and described by Mr. Stanley Williams. Nor is the Solis Lacus an isolated case. On page 118 of "Mars," Mr. Lowell writes:—

> "Certain smaller details of the change that came over the face of the dark regions at the time were as curious as they were marked. For example, the Fastigium Aryn, the tip of the triangular cape which, jutting out from the continent, forms the forked bay called the Sabaeus Sinus, and which, because of its easy identification, has been selected for the zero meridian of Martian longitudes, began in October to undergo strange metamorphoses. On October 15, it shot out a sort of tail southward. On the 16th this tail could be followed all the way to Deucalionis Regio, to which it made a bridge across from the continent, thus cutting the Sabaeus completely in two. After it had thus appeared, it continued visible up to the close of the observations sufficiently detailed to show it.
>
> "Another curious causeway of the same sort made its appearance in November, connecting the promontory known as Hammonis Cornu with Hellas. Both of these necks of orange-ochre were of more or less uniform breadth throughout."

A similar and yet longer "causeway" or "bridge" is shown by Mr. Lowell, connecting Libya with Hellas, where the Alpheus runs into the Mare Hadriaticum; and in the Memoirs of the British Astronomical Association for the oppositions of 1894 and 1898-1899, and by several observers during other oppositions, Atlantis has been described and drawn as a narrow, bright streak.

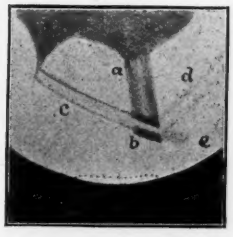
Now, these "causeways" or "bridges" are comparable in length, narrowness, and straightness to the "canals"; they differ from them in that these are light whilst those are dark. If the "canals" are formed of water and vegetation, the "causeways" are arid and denuded of all growth. If the "canals" are artificial waterways, then the "causeways" are artificial high-



Longitude 330° on the Meridian. (*From Lowell's "Mars."*)

ways. If the inhabitants of Mars find it necessary to irrigate their dry and thirsty land by stupendous irrigation works, how comes it that they find it necessary to denude their land of its hardly won growth to make a pathway at least fifty miles in breadth along a stretch of country of many hundreds of miles? Would Mr. Lowell deduce that these were martial as well as

Atlantis, 1894, Nov. 23.



Lacus Lunæ, 1894, Nov. 5.

Martian feats, and write us histories of Martian wars, and Martian armies stupendous enough to need such roads to march upon?

Surely there is a simpler and more rational explanation of all these phenomena; namely, that the rectilinear appearance of the canals and bridges is due, not to their actual diagrammatic form, but to the tendency of the human eye to link by a connecting band close objects, which, though perceived, are yet too small and faint to be individually defined. The objects are on the surface of Mars, beneath its atmosphere, and are themselves indefinite and ill-defined, but the line, by which the eye joins them up, is subjective, and is, therefore, clear, defined, definite, and, of course, straight; independent therefore of any thickness or density of the Martian atmosphere, or of any distortion due to the spherical form of the surface on which they appear to be ruled. Would it not be probable, if an observer could look down upon our own earth from a sufficient distance, that he would see the chain of the great North American lakes as one straight and even band, all gaps and irregularities being smoothed out of sight, and he would also see the string of Aleutian islands as another—the line in one instance being dark and in the other light? The hypothesis is a simple one, and rests upon a well-known law of vision; it does not certainly appeal to the love of fairy-telling inherent in each child of us; but on the other hand it does not impose so great a strain upon our intellects and imaginations.

The Expansion of Quartz-glass.

By J. G. DAVIS, A.C.G.I. (Lond.).

THE increasing use of Quartz-glass for physical apparatus exposed to wide ranges of temperature is due to its extremely small coefficient of expansion. In view of the great practical importance of this substance, it has lately been the object of several physicists to determine the true value of this constant, so as to be able to use this absolute value as a standard. Among these researches those of Le Chatelier on the expansion of fused quartz are notable. Le Chatelier heated a ring of fused quartz 1 cm. long in an electric oven, using a thermo-electric couple to register the temperature. His experiments were based on the differential method, using a prism of porcelain as a standard, and observing the relative expansion by means of an interferometer. The colours used in the interference phenomena were the yellow and green lines of Mercury. This is a modification of Fizeau's method of determining the coefficient of expansion, knowing the thickness of the plate and the observed displacement of the interference fringes. Le Chatelier came to the conclusion that for fused quartz $\alpha = 44.9 \times 10^{-8}$, and, furthermore, that this value is constant throughout a very wide range of temperature, and that there are no after effects due to heating.

Experiments at low temperatures have been carried out by Kamerlingh, Onnes, and Heuse* on rods of Jena and Thüringen glass. The rods were cooled in a bath of liquid air, but owing to faulty apparatus the results are not reliable.

The next researches of importance are those of Ayres and Shearer.† The Fizeau method was employed, and the expansion of quartz at temperatures ranging from atmospheric to that of liquid air was determined. A correction was made for the density of the air at low temperatures, using the coefficient of expansion of air at ordinary temperatures, the corresponding correction for the refractive index of the air being applied to the interferometer observations. The results obtained are not satisfactory, however, probably owing to the correction for the optical variation of the air space in the centre of the ring of rock-crystal being uncertain. There is also another inaccuracy arising from the use of

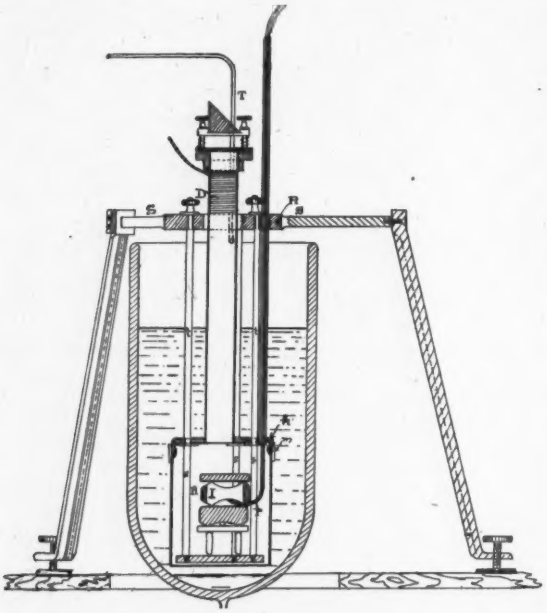
* Proc. Amsterdam, 7, 1903. † Phys. Rev., 20, 1905.

XUM

air in contact with the quartz-ring, namely, the difficulty of reading the displacement of the diffraction fringes, owing to the imperfect conductivity of air.

Recent researches by Herr Karl Scheel* at the Physikalisch Technischen Reichsanstalt at Berlin have shown that by substituting dry Hydrogen (obtained by the treatment of iron filings with acid) for air, the error due to the optical variation of the medium contained in the vessel enclosing the quartz is greatly reduced, and that furthermore, on account of the superior conductivity of Hydrogen, the system of interference fringes is clearly defined throughout the whole of the cooling process.

The accompanying diagram shows the apparatus employed. A brass ring R mounted on an iron tripod supports the enclosure by three tubes T and stays S. The enclosure itself consists of a brass tube some 3 cm. in diameter and 12 cm. long, the top of which is covered by a glass plate, rendered air-tight with wax, and prevented from cracking owing to the cooling of the brass tube by a spool of wire D heated electrically, and wound on the upper part of the tube. Above the glass plate is the adjustable fastening of the totally reflecting prism. In the bottom of the enclosure is the rock-crystal interferometer I, supported on a tripod. The platinum resistance thermometer P consists of four



insulated leads drawn through a brass tube, and cemented in with shellac at the top, so as to be rendered air-tight. The resistance wire is wound on a mica frame fitting closely inside the hollow quartz crystal cylinder I, thus leaving the central part free for the passage of beams of light, and also for the subsequent reception of bodies whose relative expansion is to be measured. For the introduction of the quartz cylinder which is to be tested, and the final sealing up of the enclosure, a rim k of the same diameter as the larger tube is "hard soldered" to a brass strip m, renewable for each experiment. The cooling vessel containing the liquid air is a cylinder some 32 cm. deep and 13 cm. in diameter, enclosed in a wooden casing to facilitate handling. To prevent the evaporation of the liquid air, a vacuum of about 0.01 mm. is obtained in this cylinder by means of a mercury air pump.

The experiments were conducted as follows:—

The cooling vessel was slowly filled with liquid air to a depth of some 12 cm., having obtained the necessary vacuum, and during the half-hour so occupied the displacement of the interference fringes was noted, the enclosure being kept filled with Hydrogen. After a period of some two hours they came to rest, and did not alter further in position for half an hour, during which time the platinum thermometer varied only 0.1° C. It was, therefore, considered that the displacement thus observed corresponded to the constant temperature registered. Hence the value of α was determined from these observations. It was noticeable that the variation of the fringe displacement and the temperature depended on the amount of liquid air used.

For one experiment four to five litres of liquid air were used, two litres at least being recovered. The spectra employed were those of Mercury, Hydrogen, and Helium.

Having once determined the absolute expansion of a ring of quartz, it was a simple matter to determine the expansion of other materials relative to this quartz-ring, and hence to calculate the absolute expansion of each. The materials so tested were turned in the form of a short cylinder, leaving only a small space between the polished surface of the cylinder itself and the quartz covering plate. The experiments were carried out on Platinum, Palladium, and Quartz-glass, in an atmosphere of Hydrogen, using the spectrum of the same gas.

A correction for the optical variation of the medium was applied in all experiments, and the results may be summarised thus:—

In general, l_t being the length at t° C., and l_o that at 0° C.

$$l_t = l_o (1 + \delta \times 10^{-6} t + \beta \times 10^{-7} t^2),$$

δ and β being constants for certain limits of temperature, whose values are given below.

Material.	Range of Temperature. ° C.	Value of δ	Value of β
QUARTZ. (In the direction of the principal axis.) The Standard Used.			
Scheel's Experiments ..	− 190° to + 16°	6.946	0.00996
Earlier Experiments ..	+ 16° to + 100°	7.144	0.00815
PLATINUM.			
Scheel's Experiments ..	− 190° to + 16°	8.615	0.00370
Earlier Experiments ..	+ 16° to + 100°	8.806	0.00195
PALLADIUM.			
Scheel's Experiments ..	− 190° to + 16°	11.303	0.00607
Earlier Experiments ..	+ 16° to + 100°	11.612	0.00323
QUARTZ-GLASS. (Amorphous Quartz.)			
Scheel's Experiments ..	− 190° to + 16°	0.217	0.002379
Earlier Experiments ..	+ 15° to + 100°	0.322	0.00141

Examining the equation for Quartz-glass, it is seen that on raising the temperature of a rod 1 metre in length from − 190° to + 16° there occurs a *diminution* in length of $41 \times 10^{-}$ metre.

This gives a mean value of α equal to 19.9×10^{-8}.

The expansion curve of this material shows a minimum at − 46° C., so that a piece of Quartz-glass having a length of 1 metre at 0°, would contract 10×10^{-6} metre when cooled to this temperature.

* Verhandlungen der Deutschen Phys. Ges., 1907.

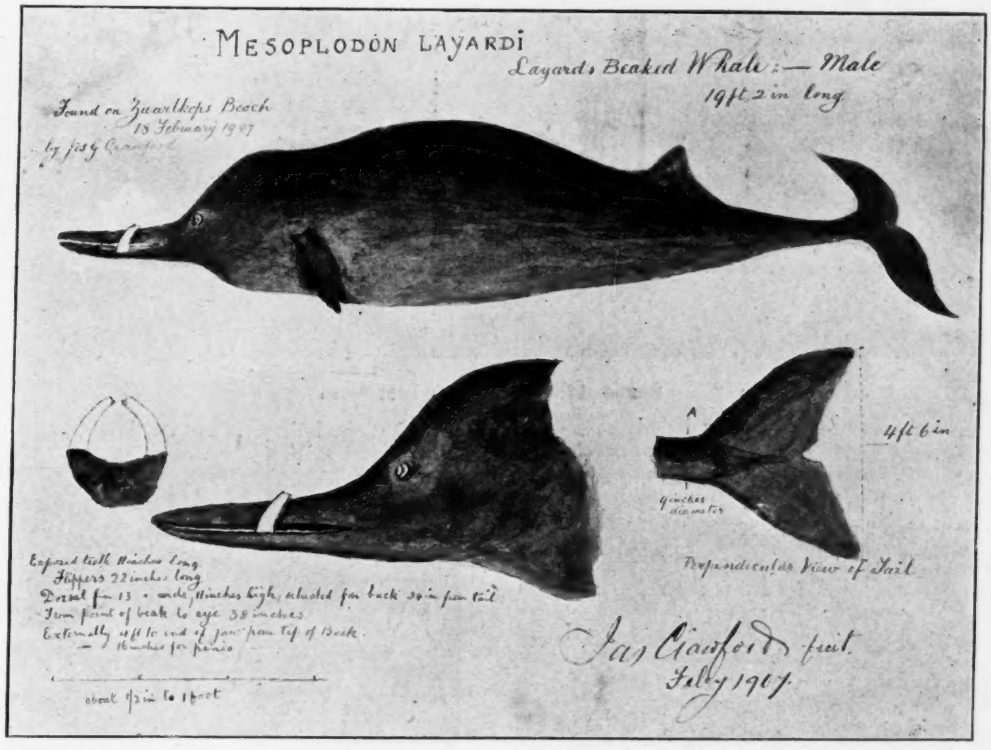
Layard's Beaked Whale.

(*Mesoplodon Layardi*.—FLOWER.)

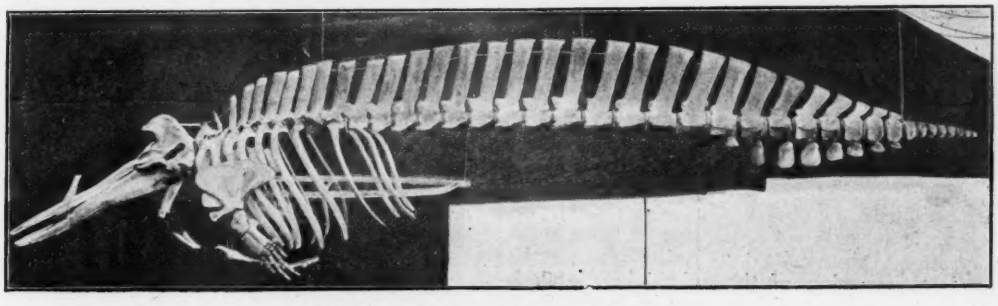
By F. W. FITZSIMONS, F.Z.S., F.R.M.S., &c. (Director of the Port Elizabeth Museum).

ON February 17, 1907, a Layard's Beaked Whale was found stranded on the beach a little south of Zwartkops River, a few miles north of Port Elizabeth, by a young man named Joseph G. Crawford. On being notified the following morning I at once dispatched my assistant to inspect the carcase and report. He brought the tusks back with him, and the animal was at once identified as Layard's Beaked Whale. We took immediate action, with the result that we now have in the Port Elizabeth Museum the skeleton mounted entire. The animal was in a state of partial decomposition when discovered; therefore it was impossible to save the skin, but accurate measurements and drawings were taken on the spot, and the coloration of the skin carefully noted.

So far very little, indeed, is known of this animal, and what little there is in books is more or less incorrect, therefore the discovery of this specimen will enable the world of science to record further knowledge and add to its illustrations on this subject. I have had various parts photographed; and a painting, drawn to scale, which was made of the animal whilst lying upon the beach is reproduced. The following are the details :—



The animal was a male, 19 feet 2 inches in length. It was entire, and showed no signs of external injury. The colour of the back was dark brown, inclining to black on the dorsal surface, gradually merging to brown on the sides and tail, becoming a whitey-brown or dirty white on the belly. In Professor Moseley's description it is stated there was a distinct line of demarcation of the two colours, black and white. In the



Skeleton of Layard's Beaked Whale.

specimen under discussion the colour gradually merged from blakish on the back, to brown on the sides and dull white on the belly, the colours harmoniously interblending, as will be observed in the illustration.

4¼ to 5 inches at the tip. The fleshy covering of the upper jaw beneath the teeth showed no mark, abrasion or wearing, indicating the animal was content to open its beak only so far as the teeth allowed. Moseley

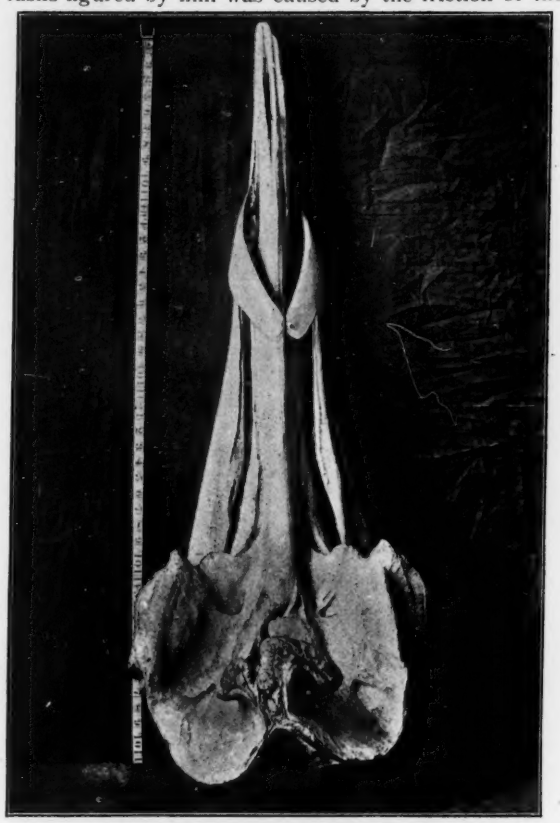
Bones of the Head—Side Elevation.

The pectorals measured 22 inches; dorsal fin, situated far back, 13 inches wide and 11 inches high; tail, 4 feet 6 inches across at extremes; from the point of the beak to the eye, 38 inches, externally (with the flesh on) to the end of the jaw, 4 feet; exposed portions of the teeth 11 inches long, and 2½ inches wide at the base, becoming slightly narrower towards the top with the conical real tooth at the forward portion of the summit. This tooth is enamelled and sharply tipped.

In the figure given by Professor Moseley in the "British Museum Catalogue of Whales," of the skull of Layard's Whale, there are marked differences when compared with our specimen. The shape of the lower jaw shows an upward bend in front, whilst in our specimen it is straight. The proportion of the slope in the upper jaw is also very dissimilar, whilst the teeth show a kind of wearing away slope toward the middle portions. The teeth of our whale are uniform from shank to tip, showing no wearing away or indications of friction whatsoever. The little real teeth at the summit of the tusks are sharp and not wart-like. Again, though the figure given by Moseley distinctly shows the teeth uniform and not crossed over one another, it distinctly states in the reading matter that they do. The various illustrations accompanying this article distinctly show the teeth uniform without any indication of crossing over one another. This fact was ascertained before the teeth were removed from the whale's jaws. They were firmly and solidly embedded in the jaw in their respective sockets.

In Sclater's "Fauna of South Africa," Vol. II., page 194, an illustration is shown of the snout of Layard's whale with the tusks crossed, and the whole drawing will be seen to have important differences when compared with the photographs of our specimen. In our specimen they do not cross over or even touch each other, there being quite two inches between the tips. A close inspection of the animal in the flesh proved the fact that it was able to open its mouth from

states that the hollowing out of the centre part of the tusks figured by him was caused by the friction of the



The Head seen from above.

snout when the animal opened its mouth. The tusks of our specimen show no sign at all of wearing, and the skin of the beak was carefully examined and showed no indication whatsoever of coming frequently in contact with any hard body. Judging from the width of the gullet this whale does not require to distend its mouth overmuch, as the gullet is only $1\frac{3}{4}$ to 2 inches in diameter, indicating that its food must be very small. The two sharp enamelled teeth at the summit of the tusks are probably used for tearing and rending soft-bodied animals, such as the octopus, and, perhaps, for tearing aside seaweeds, &c., when in search of food.

The tusks are 14 inches in total length, $2\frac{1}{2}$ inches wide at jaw, and $1\frac{3}{8}$ inches at summit beneath the conical real tooth, and from three eighths to half an inch thick. The blubber on the back was 3 inches thick and $1\frac{1}{2}$ inches on the belly The oil was of exceptionally fine quality and of great penetrating power, almost like paraffin. Owing to the advanced state of decomposition of the viscera, the stomach's contents were not examined.

Pectoral Fins.

From the foregoing it will clearly be seen that previous drawings and data in regard to Layard's Whale are more or less inaccurate, or in the present specimen we have a new species. The drawings show that the upper lip or tip of beak covers the lower, and the photographs show the upper jaw to slightly project beyond the lower. The reverse seems to be the case in Sclater's and Moseley's illustrations. The lips all along the beak were not horny, but rather like hardish flesh. The asymmetrical structure of the skull is very curious, the bulk of the frontal bones being borne from the right to the left side, giving it a distorted appearance.

The creature had apparently been injured at some previous time, as the tongue bones and two vertebræ showed distinct signs of having been fractured and repaired by the formation of fresh bony matter. One of the most remarkable features of the creature is the small pectorals or flippers as compared to the size of the body they were required to balance. The remote position of the dorsal is also rather unique. The bones are remarkably light and easily penetrated, being very porous with the exception of the skull bones. The bones of the beak are very brittle, dense, and hard.

Further information or photographs for scientific purposes can be had on application to me, if inquirers undertake to defray the small expense connected therewith.

A Curiosity of Lightning Photography.

By C. AINSWORTH MITCHELL, B.A. (Oxon.), F.I.C.

THE photograph of lightning here shown was taken during the storm of August 2, 1906, from a window in Gray's Inn. The only explanation that can be offered for the curious multiplication of the flash is that lines of windows in an opposite building came within the field of the camera, and that a series of reflections from these windows must have been recorded upon the plate. It is probable that none of the marks was due to the direct flash.

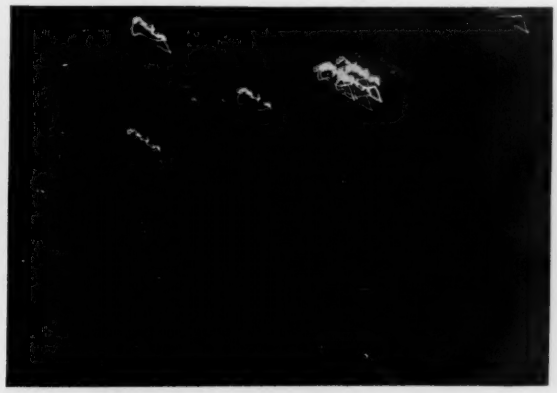


Photo. of Lightning, August 2, 1906, 9.15 p.m.

BY command of His Majesty the King, the Anthropological Institute will henceforth be known as the Royal Anthropological Institute of Great Britain and Ireland. On receipt of His Majesty's gracious command the necessary steps were at once taken to procure the re-registration of the Institute under its new title; the necessary formalities are now complete, and the change of name has been effected.

XUM

Hydraulic Ram for Driving Equatorial Reflector.

By T. E. HEATH, F.R.A.S.

A SHORT time ago I was fortunate enough to purchase, without inspection, a reflecting telescope which was so imperfect that it had to be entirely reconstructed.

I was thus compelled to think out a method of mounting and driving, which otherwise would probably not have occurred to me.

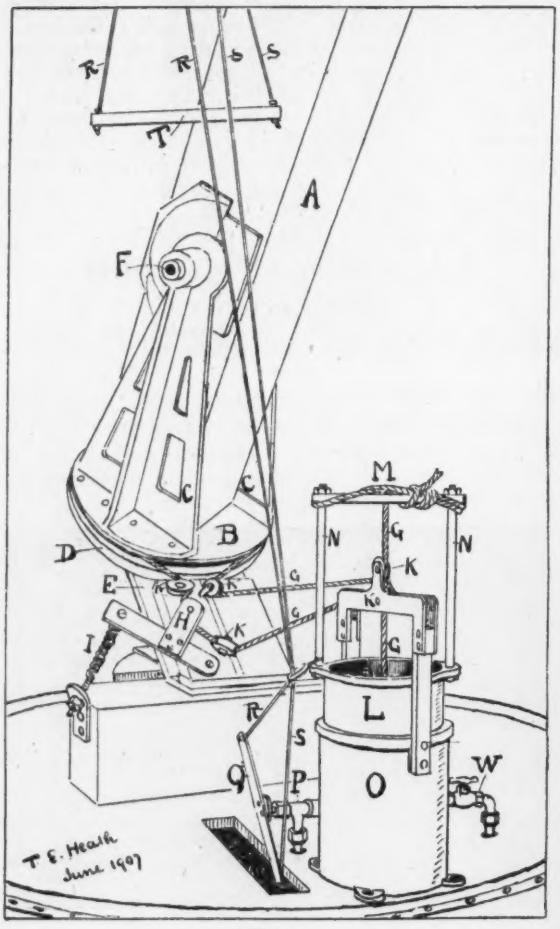


Fig. 1.

The result is so satisfactory and convenient that I have described the contrivance for the readers of "KNOWLEDGE & SCIENTIFIC NEWS," with particular reference to the drawing (Fig. 1) in which the telescope is shown pointing 90° N. (the best position for showing the general construction). I have also photographed it (Fig. 2) with the telescope pointing east, and (Fig. 3) pointing south; this last from a sufficient distance to get in all the observatory.

The first thing I did was to send the mirror and flat to Mr. Calver. The flat he considered hopeless, and made a new one. The mirror was made by Mr. With, in 1872, and by him marked: "Perfection, 8½ inches diameter, 67 inches focus"; but perfection only came after Mr. Calver had refigured it.

I had the tube made of teak, six feet long and 10 inches square inside as, for the mounting I adopted, a square tube serves well (marked A in illustrations).

The equatorial stand is made of cast-iron, so that the telescope set to 90° N. will revolve with the optical axis pointing to the pole (not revolving round it), and so that no difference is made by crossing the meridian. By about 10 pounds of lead, attached to the lower end of the telescope tube, the apparatus is truly balanced in all positions. B is the right ascension circle; 21 inches in diameter, having a groove formed round its periphery. To it there are bolted two A frames, C C, which support the declination axes at such a height that the telescope swings between them clear of the right ascension circle. D is a fixed circle which carries the bearing of the polar axis, which is of steel, 1½ inches diameter; and supports the right ascension circle upon 44 steel balls, which project slightly above a groove formed on the upper face of D. D is bolted to the base plate E at, in my case, an angle of about 38½° with the horizon. F is one of the declination axes. They are hollow, cast-iron trunnions, screwed to each side of the teak tube, and are two inches in diameter.

There is a rope G (best sash cord is suitable), which fits loosely in the bottom of the groove round the right ascension circle, and is kept taut by a tension pulley carried by a lever H, which is pulled by a spiral spring I. The rope passes over guide pulleys K, and one end of it is attached to the bottom of a hollow brass hydraulic piston L, and the other end to a cross-bar M, which is supported at a sufficient height above the piston L by the pillars N. O is a brass hydraulic cylinder

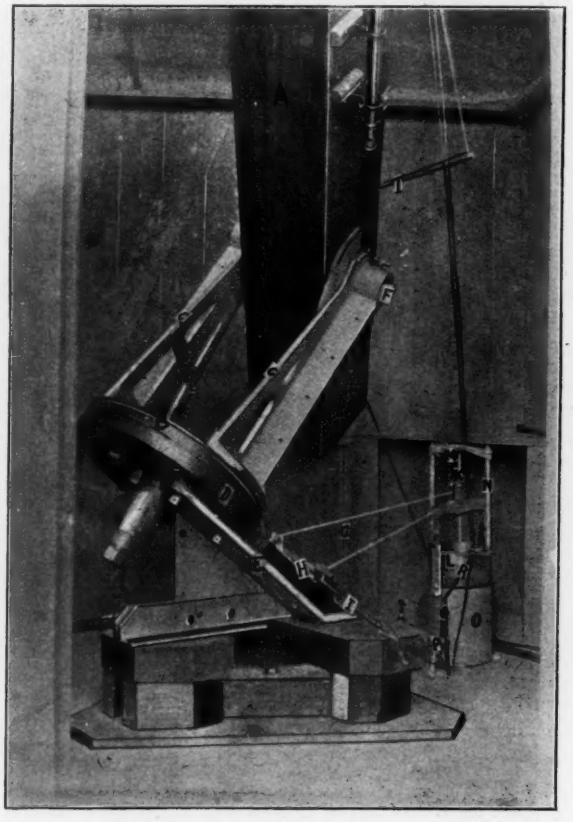


Fig. 2.

8 inches in diameter and 10 inches high, which is screwed to the floor of the observatory (a cup leather attached to bottom of piston makes a water-tight joint). The supply of liquid thereto is regulated by a valve P (I bought, price 6s. 6d., one of the valves sold for regulating the supply of oxygen from a cylinder).

There is a lever Q, which, turning through about 160 degrees, opens or closes the valve sufficiently. To one end of Q is attached a cord R, and to the other end a cord S, and the cords are led over suitable guides to each end of a bar T, which hangs from the roof conveniently near to the observer.

When observation begins the hydraulic ram is started by turning on the liquid, and it will run for about 2½ hours and then, if required, the cylinder can be emptied *in about one minute* by opening a relief valve W, and standing on the piston, without altering the inlet valve.

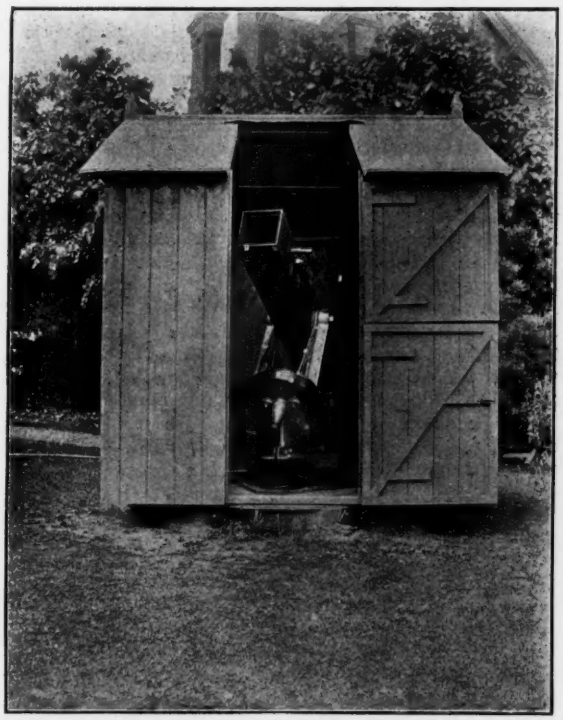


Fig. 3.

This gives another 2½ hours. I find that, if the rope be so large that it covers the bottom of the groove but does not grip the sides, and the spiral tension spring be an ordinary "door pull," the friction is not so great but that the observer can easily set the telescope on any desired star, but it is sufficient when he lets the telescope go to cause the right ascension circle to revolve. In practice, the observer turns from star to star as required, and when he lets go the telescope automatically follows. I find that with the observatory locked up, in less than five minutes of my leaving the house I have everything adjusted and the telescope following any desired star, provided I can see it; if I have to use the circles it might take a little longer.

I use, at present, water direct from the town supply, which for visual observation suffices, as it is easy, by moving the bar T, to counteract the varying pressure from the main. For photography it would obviously be better to take the liquid from a high tank in which the level is kept constant by a ball valve, and it would be preferable to use glycerine, or some not easily frozen liquid. One gallon suffices for 2½ hours, so that the waste could easily be caught in a bucket and carried back to the tank.

To take an example: On May 27, I found Jupiter with the circles at 5.50 p.m., and, although for more than an hour it was hidden by a roof, followed it till 9.5 p.m., when it set behind trees. The telescope would often run true for 20 or 30 minutes, and then the water pressure would vary so that I had to move the bar T. I had, of course, to empty the hydraulic cylinder once for a fresh start, but this gave no trouble. The motion is absolutely steady and I find it a great convenience, whilst looking through the eyepiece, to be able to increase or decrease it by turning on more or less water, *e.g.*, I got γ Lyræ with the finder and altered declination to that of the Ring Nebula and turned on a good supply of water till the Nebula drifted to the centre of the field. One can drift in either direction at any desired speed, so that it should be very useful for comet hunters.

The wooden observatory is about 8 feet square, and is supported on four wheels (one in line with each corner), which run upon a circular angle iron rail, screwed to the floor. In the four corners, forming part of the structure, are triangular cupboards, which therefore revolve with the observatory, so that the eyepieces, etc., placed upon them are always conveniently near the observer. The observatory is easily turned by pushing against one of the door posts. I shall be glad if this description is useful to others. The cost was small and the work can be done by any good fitter and carpenter. Without reckoning my time, and I only designed and directed, it cost me approximately £10 for the equatorial mount; £6 for the hydraulic clock; £10 for the wooden observatory. The mirror, flat, tube, finder, eyepieces, Zöllner star spectroscope, etc., cost about £35. I made the declination circle (12 inches diameter) and vernier out of sheet aluminium. The R. A. circle was made in the lathe by the fitter, and is so large no vernier is required.

[Since writing this article I have improved the regulation of the supply of liquid by screwing a wooden sheave 9 inches in diameter to the lever Q, to which the cords R and S are attached, and round which they are wound before being led over the guides.]

To the Editors of "KNOWLEDGE & SCIENTIFIC NEWS."

SIRS,—I have just read in the January number of your valuable paper, an interesting article on the Termite or "White Ant," wherein it is stated that "recently" these insects have been placed by themselves in an order known as "Isoptera."

May I venture to point out that as far back as 1840, M. Brullé proposed, in his work on the insects of the Morea, to form a distinct order, "Isoptera," for the "White Ants" (*vide* Westwood, Introduction to the Study of Insects, vol. ii., page 12—Ed. 1840).

It is a matter of interest to note that, in spite of the fact that the queen Termite is an almost life-long prisoner in a dark clay cell, she has, nevertheless, fully developed eyes and legs for which, apparently, she can have no use, after the marriage flight in early life.

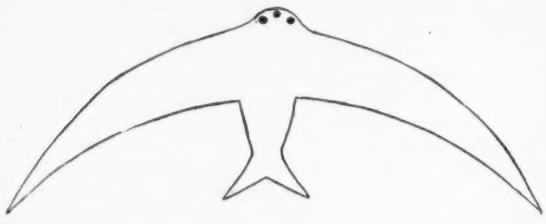
Yours, etc.,

J. WINN SAMPSON, F.R.M.S.

XUM

Lateral Stability.

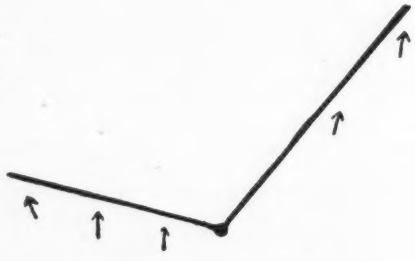
To the observations and longitudinal stability in the July number, for the substance and correction of which we are indebted to Professor Hele Shaw, it should be added that his demonstration at the Royal Society *soirée* was the first in which the action of the upward pressure of the air on a moving plane or pair of planes was made entirely clear, though the simplicity of the explanation appears remarkable. The paper "birds"



which he sent skimming also illustrated in an interesting and precise way the mechanics of lateral stability. The wings of Professor Hele Shaw's "birds" being made of paper, which was not very stiff, were capable of being curved upwards at the tips. Imagine a pair of planes thus :—

As this pair of planes moves forward it may tip to one side, thus :—

The consequences will be that the air underneath the left-hand plane rushes upward and escapes. It can do so more easily than on the right-hand side. If the planes are capable of being curved upward, as a bird's wing is, or as Professor Hele Shaw's imitative paper planes were, the air will escape more easily still. Evidently, then, the underneath pressure is greatest on the side where the air can escape less easily.



The effect will be, therefore, for the pair of planes to tip back again as above in order to equalise the pressure, and, generally speaking, there will be a decreasing oscillation towards natural stability.

The Life History of the Eel.

A VERY instructive label has recently been placed in a case in the central hall of the Natural History Museum to explain the life-history of the eel, more especially in connection with the early stages, of which examples preserved in spirit are shown in the same case. The account is of such interest that the following more or less modified transcript of the label should prove welcome to a large number of our readers.

For half a century or more naturalists have been acquainted with a small pellucid marine fish, elongate in shape, and much flattened from side to side, with a disproportionately small head. Such specimens of these fishes as were taken in the early days of its history were captured near the surface, in company with jelly-fish and other transparent creatures; and it was not long before it became evident that there were several kinds of these leptocephalids (*Leptocephalus*), as, from their ridiculously small heads, they were named.

To the astonishment of the observers, one of these leptocephalids living in an aquarium at Roscoff, Brittany, gradually became opaque and cylindrical till finally it assumed the appearance of a minute conger-eel. This put naturalists on their mettle, and in 1901, as the result of careful investigation, Messrs. Grassi and Calandruccio were enabled to demonstrate that a leptocephalid living in swarms in deep water near the Straits of Messina, was the long-sought young of the freshwater eel. It has been named *Leptocephalus brevirostris*, but this title has, of course, to give place to *Anguilla vulgaris*. The specimens taken from time to time at the surface of the ocean were merely wanderers, which from some cause or other had been driven out of their own proper zone.

As the result of these and other observations, it is now definitely known that the eel, when full-grown, makes its way down the ditches and streams leading from the ponds it inhabits into the large rivers, and so to the sea, where it descends to a depth of some 560 fathoms. On the way, its skin becomes silvery and bright, its eyes grow large and dark, while the reproductive elements (the milt and eggs) develop in both sexes.

Those eels which do not descend into the sea (for some remain land-locked) never develop reproductive organs; and, in fact, from the time of Aristotle until a few years ago no one had been able to describe with certainty the reproductive organs of the eel, owing to the fact that the adult does not become sexually mature in freshwater. In breeding eels the males have narrower snouts than females; the so-called sharp-nosed and broad-nosed eels being merely immature males and females of one and the same species.

Eels spawn at great depths in the middle of winter. The innumerable young hatched from the eggs grow to a length of nearly three inches, as the flat, transparent leptocephalids, which subsequently change their shape to become young eels or elvers.

Elvers ascend rivers in millions; "eel-fare" being the local name given to their migration. Some of the young eels climb banks and pass over wet fields till they eventually reach suitable ponds, but others stay in holes in the muddy banks of streams. Their numbers are greatly reduced as the migration proceeds, many of the elvers being eaten by fishes and birds, while vast quantities are caught and sold during the "eel-fare" for human consumption.

In the West of England "elver-cakes" are made and

eaten during the "eel-fare," the elvers being thrown into tubs of salt, and then boiled and pressed into cakes. In Italy eel-fishing is a staple industry, particularly at Comaccio and certain other parts of the Adriatic. In Naples the custom prevails of eating eels on Christmas Eve.

Every pair of eels reaching the sea produce many thousand elvers, only two of which are needed to enter freshwater to take their parents' place; the eels which have matured and gone down to the sea never returning.

In the year 1906 the breeding-ground of eels for the British Isles, Norway, Denmark, France, and Spain was discovered to be situated in the Atlantic Ocean at a depth in places of at least 550 fathoms.

The specimens which the label is intended to illustrate were obtained by the Danish Fisheries Investigation steamer *Thor*. The first leptocephalid is in the perfect larval state and ready to undergo metamorphosis; the previous stages being still unknown. In this complete stage the creature has ceased to feed, and will take no food till the change is complete.

As the change into the elver proceeds, the temporary teeth in the upper jaw are shed, and the pointed snout becomes rounded. The vent becomes gradually shifted forwards, from a position at two-thirds the total length from the snout in early stages, to two-fifths in the later ones. The back and belly fins are also pushed farther and farther forwards, the former at a greater rate than the latter. The depth of the body likewise becomes reduced—first in the anterior and posterior regions, later in the middle—until the body becomes nearly cylindrical; while in the later stages the length becomes reduced. Pigment is developed in the skin, first at the end of the tail, subsequently on the neck, and finally over the whole of the sides and back; the eyes also becoming slightly reduced in size during the change.

Photography: Pure and Applied.

By CHAPMAN JONES, F.I.C., F.C.S., &c.

New Developers. Drs. E. König and O. Strachlin, of the firm of Messrs. Meister, Lucius, and Brüning, find that triaminobenzene and triaminotoluene are advantageous as developers. The hydrochlorides of the bases are employed. Triaminobenzene may be regarded as amidol (diaminophenol) with its OH group replaced by NH_2, and it is worthy of note that the exchange in this case leads to a diminution of developing energy, for although the new developer is effective with sulphite only (without alkali) as amidol is, it develops more slowly than amidol, and may be used with alkali without any fear of fog. As compared with paradiaminobenzene, it is much more energetic, as the former is generally used with caustic alkali. The addition of the NH_2 group in this case produces its usual effect.

The toluene compound is more energetic than the other, but still does not quite equal amidol. From a comparison of these two substances, and a study of allied compounds, it is concluded that "The developing power of a benzene derivative, which contains the required minimum of two developer groups, becomes greater on the introduction of CH_3 groups into the benzene ring. The effect of a CH_3 group is especially strong when in the ortho position with regard to an OH group."

Plate Testing. Mr. R. James Wallace, of the Yerkes Observatory, has recently made various suggestions with regard to the sensitometry of photographic plates, that form a valuable contribution to this subject. His communication is reprinted in the "British Journal of Photography" (May 17, to June 7). For general sensitometry he finds that the best approximations to a standard artificial light suffer from many disadvantages that diffused daylight is free from when the sensitiveness to daylight has to be estimated. He, therefore, employs diffused light from the northern sky when the sun's altitude is at least 15°, and allows this to pass through thin "milk glass." Having no standard intensity, he adopts a standard plate instead, and finds the "Seed 27, gilt edge," the most suitable. A part of one of these is exposed with the plate to be tested in a graduating apparatus, and the results are compared after the general manner of Hurter and Driffield. He measures the densities with a spectro-photometer, but not the same as was adopted by Mees and Shepherd. For colour sensitiveness he discards coloured media for dividing up the white light in favour of spectroscopic methods. But as glass prisms give abnormal dispersion and show very much selective absorption, they are not used. Original gratings, ruled in speculum metal, also show selective absorption, which varies with the condition of their surface and the tarnish that comes with age. The celluloid replica gratings are free from these drawbacks; he therefore proposes these as standard dispersion pieces, and to ensure uniformity he generously offers to send one to any known worker who has use for it. I know by experience that these replicas are of very fine quality. They are all prepared in exactly the same way, with the same celluloid solution, from the same original, and mounted on glass of the same refractivity. The pattern of spectroscope suggested is of simple form, about 20 inches long, with two achromatic lenses of 12 inches focal length, and a moving plate carrier so that several spectra, giving different exposures, may be taken on one plate. He suggests giving the density at, say, six points in the spectrum obtained, to indicate the colour sensitiveness of the plate tested.

There is a great deal that one would like to say about the above suggestions. The adoption of the replica grating can perhaps hardly meet with anything but warm approval. But to adopt any commercial plate as a standard of sensitiveness, though it may be more advantageous than the use of any standard light yet proposed, cannot be regarded as satisfactory. We must seek for something still better. It is very doubtful whether a standard plate is possible at all, for although plates keep in usable condition for many years, there is little doubt that they all change continuously from the moment they are made. The spectro-photometer I regard as an undesirable instrument for measuring opacities. The light that is scattered during its passage through the photographic plate is largely lost and the proportion scattered is variable. The dispersion introduces fresh sources of error, leads to loss of light, and appears to offer no advantage. Much simpler apparatus can be made that will eliminate the dividing line between the two patches of light that are being compared, a point specially emphasised by Mr. Wallace, and that will be free from the disadvantages pointed out. A large proportion of the measurements that have been made since Hurter and Driffield introduced their photometer have not been measurements of opacity (or density) as they have been stated to be, because of the

XUM

loss of an uncertain amount of the variable proportion of the scattered light. It seems a pity to use apparatus that suffers from this radical defect, and to introduce disadvantageous complexities. The whole subject is a large one, but space forbids a further discussion of it here.

Lens Hoods. Since writing the paragraph that appeared last month on shading the lens, I have received from Messrs. R. and J. Beck a pamphlet (price 3d.) descriptive of the "Beck-Wheeler Telephoto. Hood," with illustrations showing the result of its use. Captain Wheeler claims, and no doubt his claim is perfectly just, that the chief reason for the fog that almost always shows itself on negatives taken with a telephoto. combination is the vast proportion of light that enters the front lens, but does not go to form the image. The hood he has devised consists of a small bellows with a metal frame at one end to screw to the lens, and a metal frame at the other end with a rectangular opening in it. These frames are supported by screw clips on a tube. By the use of aluminium, the complete thing weighs but little over four ounces, though it will take a lens mount of $1\frac{5}{8}$ in. diameter, and extend to a length of eleven inches. This apparatus solves the difficulty I referred to last month in a convenient and effective manner for telephoto. lenses. For ordinary lenses the bellows would have to be larger, and if it were attached to the camera front the lens could be changed without interfering with it. But as it would not need so great an extension for small cameras, it probably need not weigh more than the hood described above. The exclusion of useless light must be more advantageous, as the angle of view bears a smaller proportion to the angle of light that enters the front lens. While telephoto. combinations stand most in need of such precaution, all lenses, especially when used out of doors, would be the better for it.

Received. Voigtländer and Son, 12, Charterhouse Street, Holborn Circus, send their "Hints on Lenses," by Dr. Harting, which includes much sound advice and some valuable tables. This is followed by a list of the firm's lenses, cameras, and accessories. Among these are portable cameras of many kinds, and a half-plate camera with "Kiesling's Tele-Partition," the partition being a frame between the back and the front, to carry the negative lens. The partition is carried by the base board, and is adjustable on it by a rack and pinion. The book is well illustrated by examples of all kinds of work done with the firm's lenses.

Answers to Correspondents.

L. T. M. R. (Etchingham).—We can recommend "Spinning Tops," by Professor Perry (S.P.C.K.), and "Dynamics of Rotation," by Professor Worthington (Longmans), as being the most suitable books for your requirements.

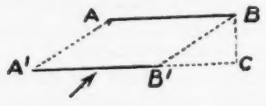
N. C. P.—In reply to your query as to the name of a book dealing with the manufacture of cyanides, the subject is fully dealt with in "The Cyanide Industry, Theoretically and Practically Considered," translated by J. A. Le Clerc from the French of R. Robine and M. Lenglen (New York: Wiley and Sons; London: Chapman and Hall; price 4 dols.). Abstracts are given of patent processes down to the year 1904. There is also a good German work on the subject "Die Technologie der Cyanverbindungen," by W. Bertelsmann, published by Oldenbourg, Munich and Berlin. Abstracts of all recently patented processes will be found in the Journal of the Society of Chemical Industry.

Practical Aerodynamics and the Theory of Aeroplanes.

By MAJOR B. BADEN-POWELL.

VI.—THE PRESSURE OF THE AIR ON INCLINED PLANES.

FROM the consideration of a plane falling and at the same time progressing horizontally, we naturally turn to what is in reality the same effect—viz., the reaction of the air on a surface inclined to it. Thus, if the plane AB falls a distance BC, while at the same time it progresses forward a distance B^1C, it will meet the air at an angle as represented by the arrow D.



The action of the air on an inclined plane is an important matter, but is one which has received but little attention from experimenters. Again we find most text-books erring, and adopting old ideas conceived hundreds of years ago. Newton gave the pressure as being in proportion to the square of the sine of the angle—that is, as the angle of inclination is increased so the pressure increases. This formula has been repeated in many books in various forms. But the subject has been more recently investigated by several good authorities.

Langley experimented with an apparatus which he called the "Resultant Pressure Recorder," by which he proved the Newtonian law just quoted to be "widely erroneous," and it is noteworthy that only after making his experiments did he come across the formula of Colonel Duchemin, published many years before, but which was found to be in close agreement with his deductions.

To summarise some of the results obtained, we may take:—

P = the resistance of the plane when perpendicular to the advance.

p = the resistance of the plane when at an angle α.

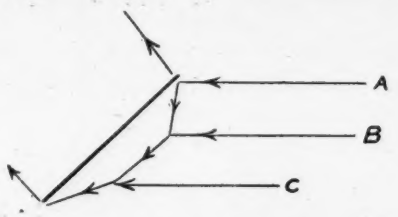
Then $\frac{p}{P}$ equals,

according to—

Newton and Euler	$\sin^2 \alpha$
Maret	$\sin \alpha$
Rayleigh	$\frac{2\pi \sin \alpha}{4 + \pi \sin \alpha}$
Gerlach	$\frac{(4+\pi) \sin \alpha}{4 + \pi \sin \alpha}$
Duchemin	$\frac{2 \sin \alpha}{1 + \sin^2 \alpha}$
Renard	$\sin \alpha \, [2 - (2-1) \sin^2 \alpha]$
Soreau	$\sin \alpha \left(1 + \frac{1}{1 + \mathrm{tg}^2 \alpha}\right)$

Chanute, in his "Progress in Flying Machines" (1894), states that he had a chart plotted "on which was delineated all the experiments on inclined surfaces which I could learn about—those of Hutton, Vince, Thibault, Duchemin, de Louvrié, Skye, the British Aeronautical Society, and W. H. Dines; and on this chart I had also plotted the curves of the various formulas." But he adds: "The whole exhibited great discrepancies, yet by patient analysis various probable sources of error were eliminated, and the conclusion was reached that the formula attributed to Duchemin was probably correct."

One of the chief peculiarities noticeable with regard to the action of the air on inclined planes is that the centre of pressure, which when the surface is perpendicular is in the centre of area, is now advanced towards the front edge. At first sight this may appear peculiar, but it is easily accounted for. The air which first strikes against the surface will be deflected off at an angle. And this current of air deflects the other currents and prevents them striking the surface with their original force. This may be better explained with the aid of a diagram.



If the top stream A strikes the inclined plane and is deflected at an angle equal to that of impact, it will be evident that the stream B, meeting this deflection will be diverted and caused to act in a direction nearly parallel with the plane. So a stream of air runs down the front of the plane acting as a cushion to detract from the effect of the lower currents.

This shifting forward of the centre of pressure was investigated in turn by Joessel in 1870, by Kummer in 1875, and by Langley in 1888.

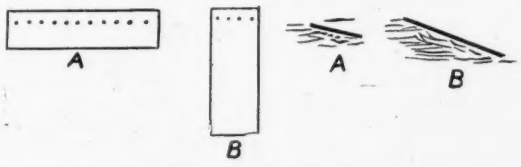
Joessel instituted the law that the distance of the centre of pressure from the centre of area,

$$= (0{\cdot}3 - 0{\cdot}3 \sin \alpha)\ L$$

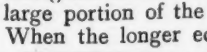
L being the length of side of a square plane.

Kummer found that much depended upon the shape of the plane, an oblong giving different results to a square.

It is well known that an oblong plane is differently affected according to whether the front edge presented to the air be the longer or the shorter one. This may be explained by the same arguments which apply to the shifting forward of the centre of pressure.



With the two planes A and B it is easy to see that if the rear part of a plane is comparatively useless, and all the effort exerted towards the front edge, then the centre of effort will come about where the dots are, and all the immense length of the afterpart of B is comparatively useless.

Then there is a further reason for loss of efficiency in a short frontaged plane like B. The air being compressed against the face of the plane forms a cushion, which if visible from the front, would appear somewhat thus being dense in the centre, but towards the edges the air can escape away at the sides, giving a more or less triangular section to the cushion of air, and therefore a large portion of the air pressure is lost over the sides. When the longer edge is presented the section would be 

NOTES.

ASTRONOMY.

By CHARLES P. BUTLER, A.R.C.Sc. (Lond.), F.R.P.S

Comet Daniel (1907 d).

THIS comet, discovered by Daniel, at Princeton, on the 9th of June last, promises to be of exceptional interest, as its brightness is rapidly increasing as it approaches perihelion, and there is reasonable hope of its becoming visible to the naked eye. At present it is easily visible with a small opera or field glass. It appears as a small, cloudy condensation, about two minutes of arc in diameter, with a very bright nucleus somewhat out of the centre. Observations of its spectrum have confirmed the presence of several bright lines, the origins of which are, however, at present unknown.

A set of revised elements and an ephemeris deduced therefrom, have been issued by the Berkeley Astronomical Department, the following being a selection from these :—

ELEMENTS.

τ = 1907, September 3·7619 G.M.T.
ω = 294° 47′·0
Ω = 143 02·4 } 1907·0
i = 9 08·7
q = 0·50639

EPHEMERIS FOR GREENWICH MEAN, MIDNIGHT.

1907.	R.A. H	M	S	Decl. °	′	Brightness.
July 4·5	1	14	0·1	+ 5	46·8	2·77
— 8·5	1	33	57	7	14·1	3·51
— 12·5	1	56	26	8	47·1	4·48
16·5	2	21	51	10	24·3	5·70
July 24·5	3	22	14	13	38·0	8·95
Aug. 1·5	4	33	54	+16	11·5	12·96

The positions have been given back for July in order to enable observers to plot anew the path of the comet, as some ephemerides have been considerably in error in R.A. The brightness is computed in terms of its magnitude on June 15, taken as unity.

The comet has travelled rather slowly in a north-easterly direction through the southern part of Aries, passing into Taurus about July 24, and will be near the bright reddish-yellow star, Aldebaran (α Tauri), on August 1.—(*Lick Observatory Bulletin*, 119, June 25, 1907.)

The following ephemeris has been computed by Dr. Smart.

1907.	R.A. H.	M.	S.	Decl. °	′
Aug. 1	4	33	56	+ 16	11
3	4	52	48	16	36
5	5	12	4	16	56
7	5	30	53	17	9
9	5	49	32	17	16
11	6	8	25	17	15
13	6	26	30	17	12
15	6	44	11	17	1
17	7	1	24	16	48
19	7	18	5	16	35
21	7	34	4	16	17
23	7	49	32	15	51
25	8	4	24	15	17
27	8	18	49	+ 14	45

(British Astronomical Association Journal, Vol. 17, p. 410.)

XUM

The Perseid Meteors.

In a paper communicated to the British Astronomical Association, Mr. W. F. Denning points out that the perseid shower of meteors should be well visible during August this year, as the moon will be new on the morning of the 9th, so that observers may be able to easily trace the paths between the 3rd and the 17th, on a fairly dark sky. The points needing particular attention are thus summarised :—

(1) Date and hour of maximum display.
(2) Number of meteors visible.
(3) Place of radiant point.
(4) Character of radiation, whether a wide area, or a contracted space.
(5) Apparent paths of brighter meteors observed.
(6) Number of meteors visible from minor showers of same epoch.
(7) Radiant points of minor showers.
(8) Condition of sky, number of observers, duration and date of observation.

It is specially to be desired that a large number of observers at various stations be on duty, so that as many instances of double or multiple records of the same object may be secured. From such data the real paths and heights of the meteors may be determined.

Spectrum Variations on the Sun's Disc.

Prior to 1873 no systematic differences in the relative intensities of the Fraunhofer lines in the spectra of various parts of the solar disc had been made, although the phenomenon of increased absorption near the limb had been under discussion. About that time Hastings observed changes in some of the lines, particularly the elimination of hazy wings, and relative inversions of intensity. Photographs of the spectra of the centre and limb were obtained by Jewell, showing notable variations of intensity, but no general conclusion appears to have been made until quite recently. Hale and Adams have recently made an exhaustive investigation of the whole spectrum from 3,600 to 7,000 at the Solar Observatory, on Mount Wilson, California, and obtained very definite results. The photographs were made on a large scale, employing a solar image of 6.7 inches (17.02 cm.) diameter, with a Littrow camera of 18 feet focus, and a plane Rowland grating with 14,438 lines to the inch. In making the exposures, the image of the sun was adjusted so that the slit was parallel to a tangent at the limb, and usually about one millimetre within it, suitable precautions being taken to prevent any light from the chromosphere entering the slit. After the exposure for the limb had been completed, a small sliding bar was moved over the slit so as to cover the portion previously exposed, and light from the centre of the sun was admitted on each side of the bar. As an illustration of the relative intensities it is stated that in the violet region it is necessary to give from eight to ten times as much exposure at the limb as at the centre, this ratio being reduced to four or five at the red end of the spectrum.

An examination of the photographs indicates that the variations in relative intensity are not very marked in the less refrangible portions of the spectrum, except in the cases of winged lines like the D lines of sodium, and the *b* lines of magnesium. In these cases the wings are greatly reduced in intensity, while the central portions of the lines are strengthened at the limb. The variations of line intensity become specially well marked in the blue and violet, while further still, from λ 3815 to 3840 especially, the appearance of the spectrum is quite changed, the wings of the lines being practically eliminated. In this respect the spectrum of the limb is different to the spot spectrum, as in the latter the winged lines of the Fraunhofer spectrum are strengthened. It is suggested that in this may rest an explanation of the extreme weakness of the sunspot spectrum in the ultra-violet region. On the other hand the changes in line intensity correspond closely with those observed in spots, lines that are strengthened in spot spectra being, as a rule, strengthened, in much smaller degree, near the sun's limb. In a long list of the affected lines given it is seen that there is a definite tendency towards a weakening of the spark lines. Not only this, there is a selective action with respect to the elements involved. The lines of Titanium and Vanadium, which are specially strengthened in spots, are less affected than the lines of manganese, iron, calcium, etc., which appear to behave more nearly as they do in spots.

There is an apparent anomaly in the case of hydrogen. The lines $H\gamma$ and $H\delta$ are weakened and narrowed at the limb, but $H\alpha$ is certainly widened, and possibly somewhat strengthened.—(*Astrophysical Journal*, 25, p. 300, June, 1907.)

New Applications of the Spectroheliograph.

(1) *Solar Photography with Sun-Spot Lines.*—In consequence of the evident importance of studying the special radiation from spots on the solar disc, Professor Hale has been recently engaged in photographing the sun, with the spectroheliograph, by means of isolated lines which are known to be characteristic of spot phenomena. In the photographs of spot spectra taken in the ordinary way, many lines are selectively strengthened or weakened, not merely in the umbra and penumbra, but in extensive regions surrounding spots. As these lines are usually narrow, it is necessary to employ large dispersion in order to be certain that none of the adjoining continuous radiation passes through the slit at the same time as the spot line. To provide for this, a spectroheliograph has been constructed having a camera lens of 30 feet focus, with a six-inch plane Rowland grating.

The first results show the umbra and penumbra much darker than they appear on the plates taken with light of the continuous spectrum. The apparent diameter of the spot also appears to be considerably increased, probably owing to the inclusion of the dark area surrounding it.

(2) *Stereoscopic Pictures of the Sun.*—By taking two photographs of the sun with the spectroheliograph at a suitable interval, it is possible to obtain a stereoscopic print showing considerable relief. In the case of one such pair, the individual plates were taken on August 22, 1906, at 7h. 26m. a.m., and 5h. 21m. p.m., respectively. Of course, during such a considerable interval the changes in the form of the flocculi are very noticeable, but they do not prevent a satisfactory comparison of the two images in the stereocomparator. The reproduction of these, which is given, shows most clearly the elevated character of the flocculous masses above the general level of the sun's surface. It is hoped that this method of direct comparison of negatives will lead to the detection of changes in details which are too insignificant to attract the eye individually.—(*Astrophysical Journal*, 25, p. 311, June, 1907.)

Transit of Mercury.

Perhaps it is not too early to remind readers that there will be a transit of Mercury on November 14 next, visible in the south of England about noon, and that intending observers would do well to arrange their programme and apparatus. The necessary particulars relating to the phenomenon will be given in a later issue.

New Spectroscopic Apparatus.

Messrs. Hilger have favoured us with a copy of their new spectroscopic list, in which attention is drawn to certain entirely new pieces of apparatus.

The Constant Deviation Spectrometer, reading wavelengths direct to within 2 Angström units, has been considerably improved in design, and provision has been made for the attachment of a photographic camera with sliding plate-holder, in place of the observing telescope, thus converting the instrument into an efficient spectrograph.

Six types of spectrographs, with ultra-violet glass prisms and lenses, or quartz trains, are now stocked, and a sample photograph taken with the smallest of these is very convincing of the excellent definition obtained.

We note that interferometers can be supplied, with either Michelson's or Fabry and Perot's arrangement of mirrors; also Jamin's pattern refractometer, and Lummer and Gehrcke Parallel Plate Spectroscope.

XUM

BOTANY.

By G. MASSEE.

Some Effects of Tree-Roots on Grasses.

EXTENDED experiments recently conducted in this country have shown clearly that fruit trees suffer very materially, and are often killed outright, when grass is allowed to grow under the tree and close up to the trunk. Various probable reasons for this effect, such as the removal of plant food and of water by the grass, also the supposed liberation of carbonic acid, which might prove injurious to the roots of the trees, were respectively demonstrated to be outside the primary cause of injury, and, finally, after seven years' work, it was concluded that the injurious effect could only be due to some poisonous substance formed in the soil by the roots of the grass.

On the other hand, it is a well-known fact that in many instances considerable difficulty is experienced in obtaining a growth of grass under trees. Mr. C. A. Jensen has given an account of certain experiments bearing on this point in *Science*. There is distinct evidence that plants produce toxic conditions in the substance in which they grow, and as a rule the excretions given off by the roots of a certain plant are more toxic to the same or a nearly related plant than to plants not so closely related. The effect of tree seedlings on the growth of wheat was tested, and after eliminating as a cause of injury such factors as removal of plant food or water by the tree-roots, it seemed that the roots of the latter had some direct effect on the growth of the wheat, which suffered in all the experiments. The seedlings were placed in plant pots, hence the roots of the tree and those of the wheat plants were in close contact. Trees of various kinds were used in the experiments, and the retarding influence, although noted in every instance, differed in degree; cherry was least active in checking growth, pine most so. The conclusion arrived at was that the effect of trees on wheat appears to be due to the excretion of substances by the trees toxic to wheat. Evidently the last word has not been said on this very important subject.

Spontaneous Heating of Hay.

The heating of newly-made hay ricks has up to the present generally been attributed to the action of bacteria. Dr. Hugo Miehe, who has made a special study of the subject, concludes that this idea is erroneous, and has proved that the heating is entirely the result of physiological action. Several thermophilous species of bacteria and fungi, of which some are new, were obtained from heated hay. Some of these proved to be more or less pathogenic, and the author considers that other injurious kinds of bacteria and fungi are probably favoured in their development by sweating manure, etc., and that the general occurrence of the tubercle bacillus may be due to the presence of such heated masses.

It is considered that such sweating and heating of the enormous masses of vegetation during early times must have aided considerably in the formation of coal.

Moss Growing in Deep Water.

F. A. Forel has described in *Archiv. Sci. Phys. Nat. Geneva*, a moss called *Thamnium lemani*, which grows submerged at a depth of 200 feet in the Lake of Geneva. This is the only known instance of a green plant growing at so great a depth in fresh water.

CHEMISTRY.

By C. AINSWORTH MITCHELL, B.A. (Oxon.), F.I.C.

Chemical Sterilisation of Water.

THE use of copper sulphate as a means of destroying bacteria in water, already described in these columns (see "KNOWLEDGE & SCIENTIFIC NEWS," 1905, p. 64), is extensively used in the United States, and in the small proportion required, appears to be without appreciable physiological effect upon man. A still more effective bactericide has now been discovered by Messrs. Paterno and Cingolani, who have found that the addition of as little as 3 milligrammes of silver fluoride to a litre of water effects complete sterilisation. The experiments were made upon waters contaminated with sewage, and purposely infected with the micro-organisms of cholera, typhoid, and diphtheria, and with *B. coli* (the characteristic intestinal bacillus), and in each case the sterilisation was perfect and permanent. Fluorides have the reputation of being extremely poisonous, and one would anticipate that this would be the case with silver fluoride, which is a very soluble salt; yet no injurious effects were observed in feeding experiments, in which dogs were given food containing small amounts of the preservative. Silver nitrate also has a strong sterilising action upon cultivations of bacteria, though to a less extent than silver fluoride.

The Action of Light upon Sulphur.

Sulphur exists in various forms, which may be classified into amorphous and crystalline, the former being insoluble, and the latter soluble in carbon bisulphide. Of the crystalline modifications, the most stable is that in the form of minute rhombic octahedra, and the small prismatic crystals which form when melted sulphur solidifies gradually change into octahedra, heat being evolved in the process. Amorphous sulphur also undergoes a gradual change into the rhombic crystalline condition, but, as Mr. Rankin has recently shown, the converse change of the crystalline into the amorphous form can be brought about by the agency of light. Thus, if a solution of rhombic sulphur in a suitable solvent be exposed to daylight, a precipitate of amorphous sulphur in produced. The intensity of illumination needed to effect the change decreases with the increase in the concentration of the solution, but more light is required when the solution is heated. Only the violet and ultra-violet rays of light are concerned in the precipitation, and the nature of the solvent does not have any influence. The precipitation is prevented by adding ammonia or sulphuretted hydrogen to the solution, and strong sunlight has then no effect. In Mr. Rankin's opinion, there is a state of equilibrium between the two forms of sulphur, one being more stable in the light and the other in the dark.

The Nature of Toad Venom.

In the last number of this journal, reference was made to *bufotaline*, a toxic substance isolated by Herr Faust from the secretion that exudes from the glands on the back of the toad. This substance is probably identical with *phrynine*, a body of an alkaloidal nature, isolated some years ago by M. Fornara, and is not a true toxine like the active principles in snake venoms, since it does not produce a specific anti-toxine, and is not destroyed by a moderate degree of heat. The toads to which the chief attention has been given are *Bufo vulgaris* and *B. viridis*, and the poisonous secretions from these have been obtained by injecting a solution of barium chloride or stimulating the skin by means of an induction coil, either of which methods causes the glands to discharge the fluid. It is a milk-white juice, which, externally applied, has a strong irritant action upon the mucous membrane and causes burning of the eye, the effects disappearing after a few hours. Introduction of the venom into the blood kills dogs within an hour, and in the case of frogs, produces convulsions, ending in paralysis and death. Alcohol and opiates act as antidotes to the poison. Toads are not susceptible to the poisonous secretions of closely allied species, though they are so to the venom of the salamander and triton. An extract of the skin of the fire-toad, *Bombinator igneus*, causes only slight twitchings in frogs, so that the powerful poison secreted by the glands of the common toad is not present in the case of this reptile. In addition to the alkaloidal poison, which is the chief active agent in toad venom, there is also present in the skin and blood of certain toads a true toxine, which acts upon the red corpuscles of the blood. This belongs to the class of toxines known as "lysines," which change the hæmoglobin in such a way that it exudes and causes the blood to become "laked." These lysines differ from

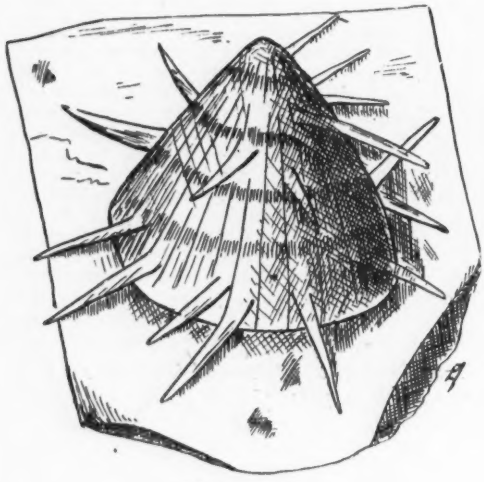
ordinary blood poisons in the fact that they produce anti-toxines, known as anti-lysines, in the blood upon which they act. The amount of *hæmolysis*, as this solvent action upon the blood is termed, may be measured by matching the colour with that of solutions of blood of known strength. In this way it has been found that, roughly speaking, the amount of hæmolysis is proportional to the concentration of the toxine. There are remarkable differences in the degrees of resistance offered by the corpuscles of the blood of different animals to the different lysines. In the case of the lysine of toad venom, or *phrynolysine*, as it is termed, the blood of the sheep is the most susceptible, and then comes, in the order named, the blood of the goat, rabbit, dog, ox, hen, and guinea-pig. The lysine has little or no action upon the blood of the pigeon, frog, or toad. Anti-bodies are not present in normal serum, but anti-lysines may readily be produced by injecting gradually increasing doses of phrynolysine. In the case of sheep's blood, for instance, 0.3 milligramme is sufficient to effect complete solution of a litre of the blood, but by immunisation it is possible to produce an anti-lysine which will afford protection to the blood against a much greater amount of the toxine. Phrynolysine has all the other general characteristics of the toxines, such as susceptibility to the action of heat and dilute chemical agents. It is present in the skin and blood of the fire-toad as well as in the blood of the garden toad. Analogous lysines have been detected in snake-venoms, though in different proportion. Cobra venom, for instance, has a much stronger hæmolytic action than rattlesnake venom.

GEOLOGY.

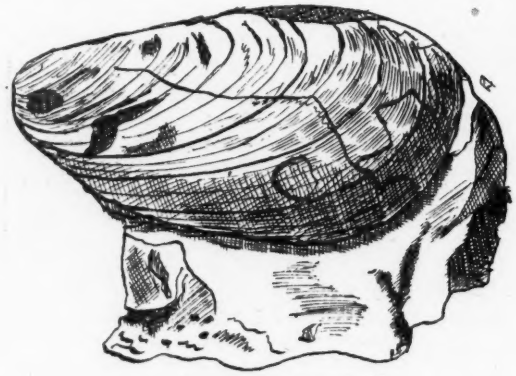
By EDWARD A. MARTIN, F.G.S.

Chalk Fossils.

OUR illustrations this month show some familiar fossils which are to be found in the chalk. Next month we hope to show some of the less familiar fossils of the same age. The chalk in some parts is more prolific in fossils than in others, this arising from the fact that different horizons, or zones, are exposed. The chalk seen between Brighton and Rottingdean will yield *Rhynconellæ* and sea-urchins, particularly the familiar *Echinocorys* (*Ananchytes*) *ovatus*. A walk from Broadstairs, round the North Foreland, to Margate, will be more prolific in fossils, particularly in sponges



Lima spinosa.



Inoceramus Brongniartii.

Corax falcatus—Chalk (Kent).

Notidanus microdon—Chalk (Sussex).

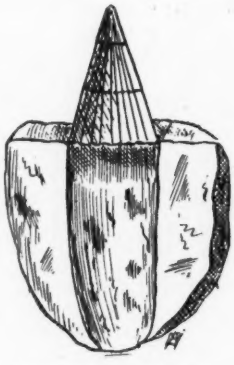
Cidaris septifera (North Foreland).

Arca (Westmeston).

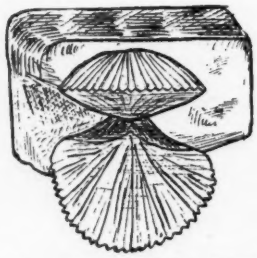
Scapanorhyncus gigas—Camb. Grnsand.

Parasmilia (Brighton).

Parasmilia centrali (Purley).



Polyptychodon continuus—Chalk (Kent). (Plesiosauria.)



Lima—Upper Cretaceous (Kent).

and spines of sea-urchins. Note, too, the persistent flint-bands. The Haling pit at Purley has lately been partly re-opened. From here the famous boulder of granite was obtained many years ago. The pit at Purley Station formerly yielded many teeth amongst other fossils, but is not now so easy of examination. The pits on the road between Lewes and Newhaven are highly fossiliferous, and are well worth visiting. Chalk-quarries are so plentiful that many other suitable spots for fossil-hunting may be found in almost every chalk district.

The Age of Niagara.

In a recent paper, Dr. J. W. Spencer has given some interesting data in respect of the "Age of the Niagara Falls." He has been engaged in investigations for a monograph on the Falls, to be published by the Geological Survey of Canada. Soundings at all the points of great changes in the Gorge have been successfully undertaken, borings were put down for the exploration of buried valleys, and instrumental surveys made of the original river-banks and the physics of the stream. The mean recession of the crest-line of the Falls is found to be 4.2 feet a year under existing conditions, and this rate has approximately obtained for 227 years. But this rate will not give the age of the Falls, on account of fewer great variations in the volume of the river and the height of the Falls themselves. The chief change in volume of water depends on the fact that originally Lake Erie alone was discharged over the Falls, when the supply of water was only one-fifteenth of the present discharge. Above Foster's Flat the sudden widening indicates the inflow of the other lakes into Erie, greater water-discharge, and greatly-increased rapidity of recession. The Whirlpool is on the site where the recession broke down the partition separating the head of the Whirlpool-St. David's buried gorge, and began to empty out the contents of this valley. The cutting with the full power of the water of the four lakes varied at times according to the height of the fall, and is calculated to have occupied 3,500 years. Thus the entire age of the Falls is given as 39,000 years.

The Coal-Bearing Oolite of Brora.

Miss M. C. Stokes, D.Sc., Ph.D., has been so fortunate as to discover a fresh bed, a mile and a quarter south of Brora (Sutherland), containing impressions of plants, showing a flora bearing a strong likeness to that of the inferior oolite of the Yorkshire coast. Previously, but one species and a second doubtful one were known from these coal-bearing beds. The bed in which the plants were found was a thin shale-band cropping out below high-tide level on the coast. According to Professor Judd's mapping, this reef would come within the boundary of the Lower Oolite. It forms a band 2 or 3 inches thick in a barren grey shale, and the impressions are fragmentary except in the case of *Ginkgo*, some of the leaves of which are practically perfect and show the veining of the lamina, and in some cases (after suitable treatment) the minute detail of the epidermis. Seven species of plants are identified, one of them being new, and most of these species are identical with those obtained from the Inferior Oolite of Yorkshire. The minute structure of the leaves of *Ginkgo* is compared with those of *G. biloba*, and proves the species to be quite distinct. The plants found are those of a land-area, probably with firm ground surrounding pools or shallow water, as indicated by the fact that *Ginkgo* and *Equisetites* are the two commonest forms.

Geology of Torquay.

"The Hills and Valleys of Torquay," is an interesting little work of 104 pages, by A. J. Jukes-Browne, F.G.S., whose name is familiar to all geologists as the author of "The Building of British Isles," and various Survey Memoirs. The work explains in a familiar manner the development of the scenery around Torquay, and is, as it is called, a study in valley development. To enjoy the book, one must know the district fairly well, and wander with it in one's hand over the eight hills on which the town is built. The illustrations, maps, and diagrams, of which there are a number, will prove of great assistance.

METEOROLOGY.

By W. MARRIOTT, F.R.MET.SOC.

Royal Agricultural Society's Show at Lincoln.

ONE of the most interesting features at the Royal Agricultural Society's recent show at Lincoln was the Agricultural Education and Forestry Exhibition. In this, the Royal Meteorological Society had an exhibit illustrating the work which the Society has recently undertaken for diffusing a knowledge of the science of meteorology. The exhibit was attractively arranged, and was intended to bring home to those engaged in agricultural pursuits the desirability of systematically studying the weather. There was a large number of diagrams relating to rainfall, temperature, sunshine, the influence of weather on crops, health, etc., and also a fine collection of photographs illustrating meteorological phenomena. A fully equipped climatological station, with the various instruments in position, was set up in a railed off enclosure in the grounds, and lectures were given by Mr. W. Marriott, on "Meteorology in Relation to Agriculture." Various patterns of meteorological instruments were also shown, as well as specimens of lightning conductors, objects damaged by lightning, etc.

The County Councils' Association also arranged an interesting exhibition relating to rural education, showing samples of the work done by children in the schools. A conference on the question of nature study in schools took place during the show, when the following subjects were discussed: (1) "What is the aim of nature study in the rural school?" speaker, Mr. T. S. Dymond. (2) "Is it advisable that children should be encouraged to make collections of natural objects in the light of the assertion that nature study leads to the despoiling of the neighbourhood?" Rev. A. Thornley. (3) "What is the system of school gardening which has the greatest value in rural education?" Mr. C. Turnor. (4) "That elementary meteorology is a desirable subject for rural education," Mr. W. Marriott.

Averages of Rainfall.

It is often very important to have some knowledge of the average rainfall of a place or district, for we are dependent upon the rainfall for our water supply. If observations have only been made for a few years, the results will probably be wide of the true average, for rainfall being so very variable, the rainfall during the period over which the observations have been made may be considerably above or below the average, and so give too high or too low a mean. Dr. H. R. Mill, the Director of the British Rainfall Organisation, has stated that at least 30 years' observations of rainfall are necessary for obtaining a true average. An interesting instance, showing the fallacy of taking too small a period on which to base a true average, is afforded by the following figures for Nottingham, for the 40 years, 1867-1906:—

Year.	Rain.	Year.	Rain.	Year.	Rain.	Year.	Rain.
	Ins.		Ins.		Ins.		Ins.
1867	**29·90**	1877	**28·77**	1887	15·64	1897	23·73
1868	**25·53**	1878	**28·84**	1888	19·99	1898	19·75
1869	**27 75**	1879	**27·31**	1889	**25·61**	1899	22·64
1870	17·93	1880	**35·45**	1890	17·70	1900	**28·53**
1871	**26·83**	1881	**27·49**	1891	**25 89**	1901	20·44
1872	**35·90**	1882	**34·38**	1892	21·58	1902	21·52
1873	20·51	1883	**30·05**	1893	20·17	1903	**32 37**
1874	18·14	1884	20·10	1894	20·25	1904	19·73
1875	**31·71**	1885	**26·66**	1895	20 75	1905	20 01
1876	**29 31**	1886	**31·76**	1896	22·99	1906	23·94

Average 20 years, 27 69 ins. Average 20 years, 22·16 ins.

The average for the whole period is 24.93 inches. The values above the average are printed in thick type, and those below are in ordinary type. It will be noticed that during the first 20 years there were only four occasions on which the rainfall was *below* the average, and that during the second 20 years, there were only four occasions on which

XUM

the rainfall was *above* the average. The annual average for the first 20 years is 27.69 inches, while for the second 20 years it is only 22.16 inches, thus showing a difference in the average of the two periods of 5.53 inches.

The Nottingham figures help to explain very largely how it has been that Leicester and other Midland districts have during recent years suffered from "water famines"; for the rainfall during the last 20 years has been almost continuously below the average, and as more water is used than formerly there has also been a lowering of the underground water-level.

The Recent Cold Weather.

The weather during the past two months has been very dull, cold, and cheerless, and has consequently had a retarding effect on the various crops. Sunday, May 12, was very warm, the temperature at the Royal Observatory, Greenwich, on that day rising to 81.5°. Cold weather set in on the 14th, and continued more or less up to July 10. The latter part of June and the early part of July were remarkable for the low day temperatures, the small amount of sunshine, and the showery weather. The following figures of the weekly differences from the average will show something of the conditions which have prevailed over the south-eastern part of England.

Differences from the weekly averages.

Week ending.	Temperature.	Rainfall.	No of Rain Days.	Sunshine
	°	Ins.		Hours.
May 23 ..	− 4·5	+ 0·08	+ 2	− 15
June 1 ..	− 1·4	+ 0·17	+ 1	− 26
,, 8 ..	− 2·5	− 0·15	0	− 18
,, 15 ..	− 0·2	+ 0·33	+ 3	− 3
,, 22 ..	− 3·5	− 0·37	− 1	+ 15
,, 29 ..	− 4·5	+ 0·17	+ 2	− 28
July 6 .	− 7·2	+ 0·23	+ 3	− 16

The cold weather was largely due to the prevalence of high barometric pressure over Iceland, and over the south-west of Europe, with a belt of lower pressure between. This distribution of pressure permitted numerous cyclonic disturbances to travel across the British Isles, with their accompaniments of dull, showery, and cold weather.

A slight fall of snow occurred at Harrogate on June 24. Though so late in the season, this is not without precedent. Mr. Richard Bentley, in his paper, "The Meteorology of Daily Life," states that he has come across mention of snow falling at Windsor on June 19, 1795, and even as far south as the Isle of Wight, on July 11, 1888.

ORNITHOLOGY.

By W. P. PYCRAFT, A.L.S., F.Z.S., M.B.O.U., &c.

The British Willow Tit.

THOUGH it seems to be commonly supposed that there is nothing new to be discovered with regard to British birds, this supposition is, as a matter of fact, far from being justified. Our native avi-fauna, in reality, presents many problems for solution. As a case in point, the question has just been raised as to whether the marsh tit (*Parus palustris*) is to be regarded as presenting two distinct phases, or varieties, or whether the supposed variety is really a distinct sub-species, which shall be known as the willow tit (*Parus atricapillus kleinschmidti*).

In the June issue of *British Birds*, Dr. P. L. Sclater objects to the proposal. Admitting that two more or less easily distinguishable forms of marsh tit are to be met with in Great Britain, he contends, however, that the one is but a variety of the other, not sufficiently distinct to justify us in raising it to the rank of a sub-species.

The Hon. Walter Rothschild, on the other hand, in the July issue of that magazine, is most positive as to the necessity of recognising what Dr. Sclater calls a variety as a distinct sub-species, which must bear the name of the willow tit (*Parus atricapillus kleinschmidti*).

From Mr. Rothschild's remarks it will be seen that very little indeed is known of the British willow tit. Those of our readers who are interested in the status of our British birds should carefully study what he has to say on the subject.

Golden Oriole in Sussex.

In the July issue of *British Birds*, Mr. Herbert Langton records the fact that a female golden oriole was caught and killed by a cat on the Marine Parade at Brighton on June 5, last. Eggs as large as No. 5 shot were found in the ovary.

Sociable Plover in Kent.

Mr. C. B. Ticehurst, in the July number of *British Birds*, records the fact that on May 3, 1907, a female sociable plover (*Vanellus gregarius*) was shot in Romney Marsh—one of a flock of six. This makes the third example obtained in the British Islands.

Barred Warbler in Kent.

At the last meeting of the British Ornithologists Club, Dr. N. F. Ticehurst exhibited a specimen of the barred warbler (*Sylvia nisoria*), one of two examples—males, by dissection—which had been killed at Woodchurch, Kent, on April 27, 1907. These make the first record of this species in Kent, and bring up the total number for the British Islands to twenty-one. Save the two Kentish examples, all the other specimens have been obtained in autumn, and were mostly immature.

The Pole-Trap in Yorkshire.

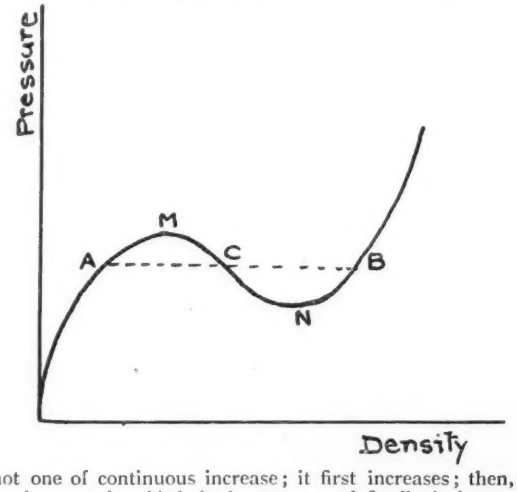
We regret to notice that, according to the *Naturalist* for July, peregrines are allowed to be caught by the barbarous pole-trap at Teesdale, in Yorkshire, without incurring police action. If true, it is time steps were taken to insist on the police doing their duty.

PHYSICS.

By PROF. ALFRED W. PORTER.

The Condensation of Water on Glass.

THE mode of condensation of water on glass is apparently a more complicated phenomenon than what has hitherto been thought. Professor F. T. Trouton, in an extension of experiments made upon condensation on different materials, finds that if successive equal amounts of water be introduced into a space containing glass wool (which has previously been dried in vacuo at 160° C. for about 70 hours by means of phosphorus pentoxide), the change of pressure is



not one of continuous increase; it first increases; then, as fresh water is added, it decreases, and finally it increases. If pressure be plotted against mass of water added, the curve obtained has a dip in it suggesting the dip in the pressure-density curve of a condensable gas, such as carbon dioxide, when the line of constant saturation-pressure A C B is replaced by the metastable lines of supersaturation A M and N B, connected by the unstable line M N as in the figure.

Professor Trouton is of the opinion that the resemblance is not merely superficial, but represents an essential identity between the two phenomena. There is one difference, however. In the deposition on glass, the sinuous curve is easily obtained; while when steam condenses into water it commonly does so abruptly, and not by a continuous transition. This is not surprising when we remember that the gas ("steam") must be enclosed in an envelope in order to be compressed along an isothermal, and that when so compressed it is in contact with material in virtually the liquid state already deposited on the walls of the containing vessel through surface condensation or absorption at an earlier stage. In presence of this liquid, the material passes over directly into the liquid form instead of traversing the continuous path. To expect it to do otherwise is not unlike attempting to obtain a supersaturated solution in presence of a crystal of the dissolved salt. It would only be in the absence of matter upon which films form that the continuous transition could take place. When we consider the formation of tht film itself, a continuous transition of water from one form of aggregation to another form is more conceivable, for it is the counterpart of an experiment in which supersaturation of a salt solution is made possible by the exclusion of crystals of the dissolved substance.

In connection with these experiments it is pointed out that phosphorus pentoxide which has been very thoroughly dried does not absorb moisture so easily as when slightly moist. Two porcelain dishes are taken; one of these is dried by heating it red-hot, while the other is left with the usual condensed moisture from the atmosphere in it. Pentoxide is placed on each, and they are put under a bell-jar. Small liquid globules appear on the oxide in the undried dish along the line of contact with it and at a few points of dust on its surface. If there is a proper amount of moisture in the vessel, the one will run liquid, while that in the dried dish remains dry except for isolated specks on its surface. By the absorption of moisture from the damp dish a substance is formed to which fresh moisture can be added without the pressure going up rapidly; such a substance absorbs moisture easily.

Standard Wave-Lengths.

In accordance with resolutions adopted at the Oxford meeting of the Solar Union in 1905, Fabry and Buisson have recently measured the wave-lengths of eighty-four standard lines (chiefly of iron) in the region of the spectrum comprised between λλ 6500 and 3600. The green line of mercury, produced by a Cooper-Hewitt lamp, was chosen as the primary standard. When it is mentioned that the discordance between independent measures rarely amounted to one part in a million, it will be realised that wave-length standards have at last been obtained, possessing the accuracy which it had been hoped the Rowland standards possessed. These measurements are given in the "Astrophysical Journal" for June.

The Spontaneous Production of Bromine from Radium Bromide.

On opening a glass tube containing a milligram of radium bromide which had been hermetically sealed for almost exactly twelve months, there was a very strong smell of bromine. Now, according to the calculations of Rutherford, the amount of the bromide decomposed in this period would be about 5.4×10^{-7} grams; the amount of bromine corresponding to this would be about 2×10^{-7} grams. It might be thought that this exceedingly minute quantity would have been beyond detection by its odour. From measurements made for me by Mr. A. C. G. Egerton, it appears that the minimum quantity so detectable is between 10^{-8} and 10^{-10} grams per cubic centimetre. Experiments are in progress with the object of determining this limit more definitely; but in the meanwhile, the evidence is quite in accordance with the assumption that the bromine detected was produced directly by the spontaneous decomposition of the bromide, and was not the result of secondary actions. As far as we know this is the first application of the olfactory sense to the detection of radioactive changes. It should be observed that the ability to apply it here arose from the cumulative character of the chemical change produced. Of course, from the ebonite cells in which radium is usually stored, the bromine can escape easily enough to prevent it being detected.

Radium Emanation and its Products.

According to a letter in *Nature* (July 18), another important discovery has been made in connection with radioactive products. Sir Wm. Ramsay and Mr. F. Soddy showed in 1903 that helium is formed as the result of the spontaneous change of radium emanation. Sir William now finds that if the emanation is in contact with and dissolved in water, neon is produced instead of helium. But, further, if a saturated solution of copper sulphate is substituted for water, argon is produced, with only a trace of neon. The importance of this discovery consists in that this is the first successful attempt to change in some way the products of disintegration. Hitherto, the mode of transformation has appeared to be an inexorable one, yielding in no way to efforts made with the hope of modifying it. How far the above modifications are attended by others has not yet been ascertained. It is possible that the emanation breaks up successively into radium A B C D E, as in the genealogical table of Rutherford. Indeed, it is probable that this is the case, for the helium or other non-valent gas is probably formed out of the Alpha particles shot off in the successive stages of decay.

Besides the above direct actions, important secondary actions occur in the surrounding medium. The copper (in the copper sulphate) seems to be partly transformed into lithium, for the red lithium line was observed after treatment, though it was very faint.

ZOOLOGY.

By R. LYDEKKER.

The Skeleton of Diprotodon.

SIXTY-NINE years ago Sir Richard (then Professor) Owen described part of the lower jaw of a gigantic extinct Australian marsupial, under the name of *Diprotodon australis*, in allusion to the armature of the extremity with a pair of large chisel-like teeth. When this lower jaw was named, its describer was of opinion that the creature to which it belonged was a near relation to the kangaroo tribe, but, as time went on, various limb-bones and an imperfect skull were obtained which tended to indicate that the systematic position of the diprotodon was, in reality, to a great extent intermediate between kangaroos and wombats. It was not, however, till 1899, when Dr. E. C. Stirling, of the Museum at Adelaide, obtained a number of its remains from the mud of Lake Cadibona, that the structure of the feet and the general form of the skeleton could be fully realised. Thanks to that gentleman, it has now been found possible to set up in the central hall of the Natural History Museum at South Kensington a complete restoration of the skeleton, in which a large number of the bones are represented by plaster models, although many of those of the limbs and feet are original specimens. As thus restored, the diprotodon is certainly a strange beast, carrying a huge head, the jaws of which are armed with teeth approximating to the kangaroo type, and having the body very short, the front limbs longer than the hind pair, and the vertebral column much arched, and falling away towards the loins, behind which it terminates in a short tail. As regards bulk, the creature may be compared to an unusually tall and short Sumatran rhinoceros; while in the matter of relationship it appears to come nearest to the wombats.

A New Elephant from Africa.

In the final report of a recent geological survey of Natal and Zululand, Dr. W. B. Scott, the well-known palæontologist of Princeton, New Jersey, gives a description of the two last lower molars of an extinct elephant obtained, in company with remains of rhinoceros, hippopotamus, and antelopes, from a deposit of late Tertiary age in Zululand. For the elephant the author proposes the name of *Elephas zulu*. Its teeth have their constituent plates more numerous and thinner than are those of the existing African species, and they are described by Dr. Scott as being to a

XUM

great extent intermediate in this respect between the latter and those of the extinct European and Asiatic *Elephas antiquus*. To myself they seem, however, to be much nearer the molars of the species last named. It is suggested that *E. zulu* may have been the ancestor of the living *E. africanus*, in which case it would almost be imperative to regard the molars of the latter as being of a degenerate type. This question requires, however, very careful consideration; but, apart from this, the discovery is one of great interest.

A Brackish-Water Jelly-Fish.

In connection with the discovery of a jelly-fish, or medusa, in Lake Moeris, of which mention is made later on, I may refer to a note by Dr. Nelson Annandale, of the Indian Museum, Calcutta, regarding the occurrence of a member of the group in brackish-water pools at Port Canning in Lower Bengal. The species is identified with *Irene ceylonensis*, which lives in the sea off the coasts of Ceylon; and its occurrence in brackish-water in Bengal indicates that these organisms may gradually become suited to a life in fresh water. In the Port Canning pool the medusas were abundant, especially near the middle, where their movements were not hampered by weeds. None were sexually mature, and their diameters ranged from one to about twenty millimetres. They were sluggish in their movements, their "umbrellas" contracting only at considerable intervals, although the contractions became more frequent just before a period of repose. Specimens in the immature hydra-stage were found growing on the margin of the pool.

Papers Read.

At the final meeting of the Zoological Society of London for the session 1906-7, held in Hanover Square on June 18, the announcement was made of the occurrence of a medusa in Lake Moeris, in the Fayum district of Egypt; while Mr. R. T. Günther contributed notes on the fresh water medusas of the genus *Limnocnida* from Lake Tanganyika and the Victoria Nyanza. Variation in the structure of corals, due to different growth-periods, was discussed by Dr. F. W. Jones, who pointed out that such variations had been made the basis of specific distinction. Mr. G. A. Boulenger read a note on a certain nominal species of lizard; and Mr. C. T. Regan described some fishes of the genus *Velifer*, and also gave his views with regard to the classification and affinities of another group of fishes. A revision of the African guenon monkeys of the genus *Cercopithecus* formed the subject of a communication by the superintendent of the Society's Gardens, Mr. R. I. Pocock, who also made the interesting announcement that the colour of the African tiger-cat (*Felis chrysothrix*) changes during life from red to grey, thus suggesting that certain geographical races named on the evidence of such colour-phases are invalid.

CORRESPONDENCE.

Heated Rock.

To the Editors of "KNOWLEDGE & SCIENTIFIC NEWS."

SIRS,—I send you a copy of the *Tasmanian Mercury*, which has just reached me. It contains the following reference to an interesting rock:—

"Mr. C. H. Morgan writes:—In your issue of the 21st March, 1907, I cut slips out relating to ignition of rocks at Burrowa; and not seeing any solution of the phenomenon in later issues, I forwarded same to my son, Mr. P. G. Morgan, B.Sc., M.A., of the New Zealand University, asking for a solution. To-day I received the following:—'The heating of the Burrowa copper ore is not a geological problem, but a chemical one, quite easy and simple of explanation. The "stone" is no doubt chalcopyrite (sulphide of iron and copper), and the heating is caused by the combination of atmospheric oxygen with the sulphur, iron, and copper, It is common enough for mines in sulphide minerals to become quite hot through the slow oxidation (equivalent to combustion) of the sulphides. If the broken ore is piled in a heap, and moderately watered, intense heat, and even flame, will finally result. The extent to which this action will take place with chalcopyrite, etc., depends not only upon the chemical composition, but upon size of heap, amount of moisture present, amount of air, physical condition (the more fine stuff, the greater the heating), etc. In the case referred to, the "stone" preserved its hardness after exposure, presumably because the heat was sufficient to fuse, or half fuse, the burnt residue of copper and iron oxide, silica, undecomposed ore, etc. I notice no details are given as to the composition of the ore, or its physical condition, but it is not likely that any competent scientific man would find difficulty in explaining the phenomenon.'"

You will, perhaps, make use of this.

CECIL CARUS-WILSON.

Folkestone.

Precipitation of Mists.

To the Editors of "KNOWLEDGE & SCIENTIFIC NEWS."

SIRS,—In the concluding paragraph of Mr. Martin's paper on "Dew Ponds" (p. 109) he says that "Old Surrey people do not use the term 'dew-ponds' at all . . . but call them 'mist-ponds.'" This reminded me of some remarkable experiments made by the eminent botanist, Dr. Marloth, of Cape Town, in order to ascertain the amount of precipitation derived from the "blanket" of white mist which visitors will recall as frequently covering Table Mountain in the dry season, whenever a S.E. wind blew. The vegetation on the top is far more luxuriant and more mesophytic if not hygrophytic in character than that on the lower slopes and "flats," which is extremely xerophytic. His method is thus described by himself:—

"In November, 1901, I took two five-inch rain gauges to the top of Table Mountain, and placed them about midway between the east and west ends of the upper plateau. One I left open in the usual way, the other one I surmounted with a framework representing a bunch of reeds. The arrangement consisted of two rings of five inches diameter, which were connected by four rods of stout wire, the whole frame being one foot high. Pieces of wire netting were fixed inside the rings and reeds were drawn through the meshes and fastened with thin wire. The frame was then inserted into the other rain gauge, fitting into its opening by means of a narrow socket. Four wires attached at opposite sides, and fastened to stones near by, protected the frame against the fury of the wind. I had consequently one ordinary gauge and one with an imitation bunch of reeds, one foot high.

"The following table gives the results of the readings from December 21, 1902, to February 15, 1903:—

Period.	Open Gauge.	Gauge with Reeds.	Differences.
Dec. 21, 1902-Jan. 1, 1903	—	15·22	15·22
Jan. 1-11, 1903	—	14·04	14 64
Jan. 11-18, 1903	1·04	16·66 (full)	15·62
Jan. 18-Feb. 1, 1903	3·51	16·66 ,,	13·15
Feb. 1-15, 1903	0·42	16·66 ,,	16·24
Total	4·97	79·84	74·87

"The gauge at Maclear's Beacon from December 17, 1902, to February 16, 1903, was 6.99. This result is, that from December 21, 1902, to February 15, 1903, that is, in 56 days, the gauge with the reeds had condensed a quantity of moisture equivalent to 74·87 inches of rain, and that quantity was recorded, although the last three times the gauge had overflowed. It is not too much to assume, that as the season of the south-east clouds extends over double that time, there would consequently be a condensation of moisture, exclusive of all rain, of at least 150 inches during the dry season alone."

Now, this suggests a practical matter. It would not be difficult to provide the small ponds on the chalk downs (on which I have often seen dense "blankets" covering the summits) with slender, much-branching stems, fixed firmly in the clay; and to see if a pond thus provided did, or did not, accumulate more water than others not so provided.

GEORGE HENSLOW.

REVIEWS OF BOOKS.

BIOGRAPHY.

John Dalton, by J. P. Millington, M.A., B.Sc.; pp. xii. and 225; English Men of Science Series (London: Dent and Co.).—A biographer of Dalton has little material to draw upon with the exception of the records of his scientific work and a few letters, for the founder of the atomic theory led a retired life and took little part in the religious or political movements of his day. In many respects he recalls his predecessor Priestley, though he lacked the spirit of unrest that animated the latter. Dalton's life, on the contrary, was quiet and uneventful, the life of a student patiently collecting facts and building his theories upon them. His lasting claim to remembrance rests upon his brilliant hypothesis of the atomic theory—a theory which correlated isolated chemical facts, making them parts of one complete system, and from which chemistry as a science may be said to have had its birth. Mr. Millington has given us a concise and readable account of Dalton and his work, and although the work may be too much to the fore for the general reader, that is not the fault of the writer of the biography.

METEOROLOGY.

Stonyhurst College Observatory; Results of Meteorological and Magnetical Observations, with Report and Notes of the Director, Rev. W. Sidgreaves, S.J., F.R.A.S., 1906. Clitheroe: 1907; 8vo., vi. and 56 pp.—This Observatory is in North Lancashire, near Whalley and Clitheroe, the latitude being 53° 50′ 40″ N., the longitude, 9m., 52.68s. W., and the height above sea-level 381 feet. The year 1906 was an average year for atmospheric pressure and temperature; but the rainfall was nearly three inches above the average. May was a remarkably cold and wet month, with a rainfall a little more than two inches above the average, a mean temperature 7.4° below the average, and a sunshine record of less than half its average duration, showing only about 16 per cent. of its possible duration. September, on the contrary, was an exceptionally bright month, with 175.6 hours of bright sunshine (over 46 per cent. of the possible number), and nearly three inches of rain less than the average. The beginning of the same month, September, was marked by a high temperature wave, the highest temperatures of the year being 83.4° on the 1st, and 83.9° on the 2nd. January, October, and December were the wettest months, with over six inches of rain in each. The wind storms of the year were not heavy, the highest velocity registered being 43 miles in the hour.

The solar surface was under observation on all available days during the year, and 210 drawings of spots and faculæ were made. The mean disc area of the spots (in units of one five-thousandth the visible surface) appears at 4.79; and the mean daily range of the magnetic declination (in minutes of arc) at 14.2. The mean magnetic declination for the year was 17° 46.9′ W., and the mean horizontal force 0.17394 C.G.S. units.

PHYSICS.

Conduction of Electricity Through Gases. Prof. J. J. Thomson (Cambridge University Press).—This is the second edition of a noteworthy work. Numerous additions have been made, and a considerable part of it has been re-written. The reader will find that the changes made have rendered it easier to follow the rapid advance in this branch of science during the last few years. No one who wishes to be abreast of the recent work on conduction in gases can afford to be without this volume.

ZOOLOGY.

European Animals: Their Geological History and Geographical Distribution, by R. F. Scharff (London: Constable; 1907; pp. xiv. and 258; price 7s. 6d. net).—The origin and migrations of the predecessors of the fauna of modern Europe and their bearing on changes during the Tertiary period in the configuration of our continent form a subject to which Dr. Scharff has devoted much time and attention. He is already well-known to students of zoological distribution as the author of the "History of the European Fauna," and last year he gave a course of Swiney lectures on the same subject, which forms the basis of the volume before us. His views are therefore entitled to special consideration, as being those of an expert, and on this ground alone we are glad to welcome the present work, as a permanent record of his investigations and conclusions. Apart from, and quite independent of, whether the theories advanced in it are true or not, the book has a great value on account of the large amount of information on a wide subject to be found in its pages, and nowhere else in a collected form. If we are ever to find any satisfactory explanation of the many puzzles presented by the distribution of modern animals, Dr. Scharff is convinced that the clue lies in their past history; and there can be little doubt that this is the true view. He is, moreover, a firm believer in the "mobility of continents" (if we may coin an expression); and he certainly makes full use of this belief to cut any inconvenient gordian knots. Non-volant land animals (especially mammals and molluscs), with a certain number of marine and freshwater groups, afford, in his opinion, the most trustworthy witnesses in regard to past changes in land-configuration; for he is convinced that such means of dispersal as the carrying of ova on the feet of birds, or the floating of snails across straits or other sea-channels are practically negligible, consequently whenever we find identical or allied species entirely cut off from one another by sea, we must assume a land connection at no very distant epoch between the areas they respectively inhabit. Conversely, the same holds in the case of allied organisms inhabiting widely sundered lakes or inland seas, or the latter and the ocean itself. How extensive the author believes such changes to have been, we will leave the reader to gather for himself by a perusal of the chapters on the Spanish Peninsula and Eastern Europe. One fault, and one only, we have to find with the author, namely, in giving the name of a well-known American rodent to the desmans of the Pyrenees and Russia.

MISCELLANEOUS.

Thunder and Lightning, by Camille Flammarion, translated by Walter Mostyn (Chatto and Windus, 6s. net).—It seems a pity that translations of good foreign books often fall far short of the originals, and that this is not due solely to the difficulties of the exact rendering of the meaning of the author, but to a desire to economise and curtail details considered superfluous in the book as it appeared. This may be said of the volume before us. The translation, too, is often far from correct. What, for instance, is meant by "watching electricity being released from a roll of amber?" and why, in an explanation of the rolling of thunder, should it be said "if the *astronomer* is not exactly under," &c.? But the book, as a book, is one full of interesting reading. The subject appeals to us all, and is full of mystery and waywardness. The effects of lightning on mankind, on animals, on trees, and on buildings are described, as well as the phenomena itself, and a chapter is added on lightning conductors. The book contains a reproduction of a fine photograph of the Eiffel Tower being struck by a triple flash, and there are a couple of photographs of electric sparks.

Nature Study Post Cards. The Country Press, of Kensington, W., have just issued two more of their sixpenny packets of instructive nature study post cards. Of the packets to hand one contains photographs of six British trees in winter; the other of the boles of the same trees, each picture being accompanied by letterpress description. The previous sets comprise all the British ferns on a set of seven, the leaves of the principal British trees and shrubs on twelve, and a selection of British grasses also on twelve cards. At a small cost, therefore, those interested in this department of science can obtain a set of these reproductions.

On Fermentation, by A. E. Taylor, University of California Publications. Pathology, No. 8, 1907.—In this exhaustive treatise the student will find a full account of practically all that is known about ferments and fermentation. The importance of such a knowledge in connection with the study of bacteria and microbes is self-evident, but it unfortunately happens that as regards the relations of ferment action to the processes of disease, we at present possess more uncultivated than cultivated territory.

XUM

MICROSCOPY

Conducted by F. SHILLINGTON SCALES, B.A., F.R.M.S.

The Preparation of Microscopical Objects.

(*Continued from page* 166.)

The strains set up in the various tissues even by the use of graduated alcohols are illustrated by the diffusion currents plainly set up when the section is transferred from one strength to the other. The currents are visible to the eye, and the section often spins round with vigour. For this reason very delicate tissues may even need the use of a special diffusion apparatus, such as is described in Lee's "Microtomist's Vade-Mecum," which consists of a tube closed with a cork at one end and with a diaphragm of chamois-leather at the other end. The section is put into this tube in the alcohol of the weaker strength, and then immersed in the stronger alcohol, the diaphragm allowing a gradual and safe diffusion between the two.

The water having been got rid of by means of alcohol, this last must itself be got rid of, the process being known as *clearing*. Strictly speaking, a clearing agent is a liquid which has a refractive index very nearly as high as the object to be cleared, and which causes the object to become proportionately transparent, but it so happens that all reagents used for extracting alcohol have also high refractive indices and, therefore, the term is used indiscriminately to imply a fluid which both clears and extracts alcohol.

The clearing agents in commonest use are given below, with their respective refractive indices, taken from Lee.

Oil of bergamot	1.464
Oil of turpentine	1.473
Xylol	1.497
Cedar-wood oil (unthickened)	1.510
Oil of cloves	1.533
Anilin oil	1.580

Of these it may be stated that oil of cloves and aniline oil absorb water most readily, even below 90 per cent. alcohol, whilst oil of bergamot comes next. Xylol absorbs water well if the alcohol is not less than 95 per cent., but is slow in action. Cedar-wood oil is superior to xylol in this respect. Chloroform takes up water well, but is too volatile. Xylol, bensole, chloroform, clove oil, and turpentine dissolve paraffin well, and the former is, therefore, much used for preparing sections that have been cut in paraffin for mounting in Canada balsam. Anilin oil is most used for preparing celloidin sections, because of its solvent action on that substance. Cedar-wood oil and oil of bergamot clear celloidin well without dissolving it. These last have also only slight action upon anilin stains, which are rapidly discharged by clove oil. Turpentine shrinks the tissues very badly, and makes them very brittle; oil of cloves has the same tendency in a less degree, but is an excellent medium in which to make fine dissections; xylol clears well, but slowly; cedar oil is very penetrating, most useful in preparing sections for paraffin embedding, and I have never known it cause shrinkage in the most delicate tissues whilst it leaves them very pliable, but it does not extract water well much below 95 per cent. alcohol. On the whole I think cedar oil is the most reliable clearing agent, and the one which will cause least loss of sections. Moreover, tissues can be left in it for an almost unlimited time without harm. One clearing agent which I have not yet mentioned is carbolic acid. It clears sections in which there is still a good deal of water excellently, but they are apt to shrink in the Canada balsam after mounting. After cedar oil I prefer xylol.

So much for the choice of clearing agent. The section, having been carefully dehydrated, is then put into the selected de-alcoholising and clearing agent for a variable time until clear and transparent, this being the last stage of all before the actual mounting in Canada balsam. There are one or two points still to be mentioned, however. The clearing agents must be kept scrupulously free from moisture, even that of the breath, or of the atmosphere, or they will become cloudy and inefficient. The more nearly the refractive index approaches that of the tissues the more transparent will the object become, and *vice versâ*, but the less contrast will, of course, be shown, especially when mounted in Canada balsam. In transferring from the last alcohol to the clearing agent no more of the former should be removed than is unavoidable, and it is a good plan to touch the edge of the section momentarily in passing against some smooth filter paper (blotting paper is too fluffy, and may give trouble with loose fibres) to get rid of the excess. The sections must on no account be allowed to get dry or they will be irretrievably ruined. To prevent shrinkage of delicate tissues Mr. Lee's plan may be adopted, *i.e.*, the placing of the clearing medium in a tube or watch-glass *under* the alcohol by means of a pipette, so as to form two distinct layers. The section is then gently inserted, and will float at the junction of the two liquids until it is saturated with the clearing agent, when it will slowly sink to the bottom, after which the alcohol can be pipetted off.

(*To be continued.*)

Royal Microscopical Society.

June 19th.—The Rt. Hon. Lord Avebury, P.C., F.R.S., President, in the chair. Dr. Hebb called attention to a slide of cow's hair presented by Mr. J. E. Lord, which showed a wool-like structure. Mr. Lord stated in a letter that hair of this sort was used in making certain felts for exportation to a foreign part, and that such felts had been refused admission on the ground that they contained wool, and would thus come under a high tariff. This led to an examination of the felts, and the wool-like hair was traced to the cow. Hair found on many goats, the llama, and the camel is commercially known as wool. Dr. Hebb showed two interesting slides of fluid crystals. He said an intermediate physical state existed between the solid and liquid forms of matter, *i.e.*, some substances presented themselves as liquids whilst retaining certain characteritics of their solid state. This intermediate state had been found to occur in animal tissues, and it was to Adami and Aschoff that we owed the demonstration of potential fluid crystals in certain organs, *e.g.*, the adrenal gland. The slides exhibited were sections cut from the fresh tissue of the adrenal gland. In one illuminated by ordinary light, the sphero-crystals were indistinguishable from common fat globules, but in one illuminated by polarised light they evidently possessed the power of double refraction and exhibed a well-marked black crop. Mr. Rousselet exhibited a fine slide of a group of six mounted specimens of Stephanoceros. The Secretary read a paper by Mr. E. M. Nelson, on "Eye-Pieces for the Microscope,"

XUM

referring to a new eye-piece described by Mr. Nelson in 1900, and which in his own work had quite superseded the compensating form. They could be produced at a cost only slightly exceeding the ordinary Huyghenian form, as they consist of only two biconvex lenses. Between these the refractions are equally divided, and the equation for achromatism, given by Coddington and others, is also satisfied. A table for the construction of eye-pieces of various powers was given. Mr. F. Enock gave his lecture on the life history of the tiger beetle, illustrating it with beautiful lantern slides.

Quekett Microscopical Club.

June 21.—Mr. C. F. Rousselet, F.R.M.S., read a paper on "*Brachionus sericus*, n.sp., and a new variety of *Brachionus quadratus*." The author said he had known this form since 1895, and after having seen and studied most of the known species, was now able to add it to the Rotatorian fauna as a good new species. A description of the specific characters followed. He had found it at Totteridge, in 1895, and since then in several other places round London, and had received specimens from Dundee and Exeter. In general appearance *B. sericus* resembles *B. urceolaris*, and no doubt has often been mistaken for that form. The male had been obtained by hatching male eggs. Mr. Rousselet then described *B. quadratus var. rotundus*, n. var., obtained by Mr. John Hood, near Dundee, about two years ago. A few remarks were also made on *B. rubens*, Ehrenberg, and reference was made to its unique habit of attaching itself to water-fleas. It was suggested that an interesting biological problem was here presented in that this species has learned to make systematic use of *Daphnia pulex* as a means of easy locomotion, while the closely-allied species, *B. urceolaris*, living in identical surroundings, had not yet acquired this useful habit, and the author thought that there must be a corresponding difference in the quality of the brain of these two species which has enabled the one to discover and make use of a means of locomotion which the other has not yet thought of.

Cultivation and Preservation of Mycetozoa.

In the June issue of the Journal of the Royal Microscopical Society, Mr. A. E. Hilton's method for the cultivation and preservation of Mycetozoa is given, which may be of service to those of my readers who are interested in these organisms. Short pieces of branches about 8 inches long by about 1½ inches diameter are taken, kept moist, and examined twice or thrice a week. The simplest way to keep them moist is to take ordinary glass jars, such as pounds of preserves are sold in, to stand the pieces on end, one in each jar, pour in water to the depth of an inch, and replenish from time to time as necessary. Another way is to take shallow baking tins, cover the bottoms with "felting" or similar fibrous material to retain moisture, keep wet by adding water as required, and to lay the pieces of wood side by side. Spring and autumn are the most favourable seasons for Mycetozoa, as cold, hot, or dry weather does not suit them. In the course of a fortnight or less, sporangia usually appear, generally in considerable numbers. Specimens of *Arcyria*, *Comatricha*, *Brefeldia*, etc., have been obtained in this way. Branches found in Highgate Woods generally produce *Comatricha obtusata*. Plasmodia of *Badhamia utricularis* can be cultivated from sclerotia, by moistening the latter in a dish with fragments of fungi, either *Stereum hirsutum* or *Auricularia mesenterica*. A little water must be added occasionally, and a sheet of glass should be placed so as nearly to cover the dish and prevent too rapid evaporation. Plasmodia grow more rapidly on *Stereum* than on *Auricularia*, but the *Stereum* must be removed when the plasmodia have passed over them or they may putrify and kill the plasmodia. The best temperature is 50° to 55° F. When plasmodia are sufficiently developed, the withholding of food and gradual lessening of moisture induce the formation of sporangia.

To preserve sporangia for exhibition under the microscope they must be set aside in a dry place until all moisture has evaporated, and then mounted in air, in deep glass cells. A small ledge of cork may be stuck to the centre of the cell, and on this the leaf, bark, or other substance on which the sporangia have been found may be fastened with shellac, or other adhesive, and when quite dry the cell may be closed with a cover-glass. Any jarring must be guarded against, or the frail sporangia may fall to pieces.

These objects should be illuminated as opaque objects, and pleasing effects can be obtained by placing behind the slide, and therefore out of focus, a background formed by a piece of coloured paper, or white paper with a piece of blue or green gelatine laid upon it.

Notes and Queries.

Apochromatic (*Johannesburg*).—If you wish to provide yourself with apochromatic lenses you will be wise to get those made by Zeiss. A useful selection for the long tube length would be ½// of N.A. .65; ¼// of N.A. .95; and ⅛// oil-immersion of N.A. 1.4. These would cost you £36. The 1// is not now made. For the short tube length I would recommend the ⅔// of N.A. .30; the ⅓// of N.A. .65; the ⅙// of N.A. .95; and the $\frac{1}{12}$// oil-immersion of N.A. 1.3. These would cost you £31. You could omit the ⅔// if you wish, as a first-rate achromatic is generally good enough for low power work. But I would warn you that it is only in skilled hands and on critical objects that the apochromatic lenses show any advantage over the beautiful achromatics of the present day, and of the best makers. Even then the difference is less great than you might expect. If you have my "Elementary Microscopy," refer to pages 65 to 70, where the whole question of apochromatic versus achromatic objectives, and the choice of lenses of both descriptions, is discussed in greater detail than I can permit myself here. With regard to your other questions, there is no advantage in getting a higher power than a $\frac{1}{12}$// oil-immersion, as the value of an objective depends on its numerical aperture, and a ⅛// or a $\frac{1}{12}$// of N.A. 1.40 will give the greatest possible resolution at present practicable with sufficient magnification to make it evident to the eye. For the $\frac{1}{12}$// I have indeed recommended a smaller aperture, as there are drawbacks incidental to the $\frac{1}{12}$// of N.A. 1.4, which make its slightly increased resolving power insufficient to counterbalance the disadvantages attendant on its use.

T. W. B. (*Bristol*).—I am sorry that I cannot give you any information as to the value of slides bearing microscopic writings, by Mr. F. G. Farrants, but I know similar slides by Mr. Webb are now difficult to procure. I would suggest your applying to Messrs. W. Watson and Sons, of 313, High Holborn, W.C., who used to offer Mr. Webb's slides for sale, and could probably give you some idea of the value of those you have. Nor do I know anything about Mr. Farrants himself. Can any of my readers give any information on the subject?

Stereo-Photomicrographs.—Messrs. R. and J. Beck, of Cornhill, send me a list of stereo-photomicrographs, from negatives, by Mr. H. Taverner, as recently presented by him to the Quekett Club. They include Foraminifera, Diatomaceæ, and various subjects from pond-life. The prints cost 1s. 6d. each, and the transparencies 3s. each.

[*Communications and inquiries on Microscopical matters should be addressed to F. Shillington Scales, "Jersey," St. Barnabas Road, Cambridge. Correspondents are requested not to send specimens to be named.*]

XUM

The Face of the Sky for August.

By W. SHACKLETON, F.R.A.S.

THE SUN.—On the 1st the Sun rises at 4.23 and sets at 7.48; on the 31st he rises at 5.10 and sets at 6.49.

Sunspots are fairly numerous; at the time of writing several conspicuous groups are visible on the solar disc.

The positions of the Sun's axis, centre of the disc, and heliographic longitude of the centre are given in the following table:—

Date.	Axis inclined from N. point.	Centre N. of Sun's Equator.	Heliographic Longitude of Centre of Disc.
August 4 ..	11° 51′E	6° 2′	179° 15′
,, 9 ..	13° 46′E	6° 21′	113° 8′
,, 14 ..	15° 34′E	6° 37′	47° 3′
,, 19 ..	17° 16′E	6° 51′	340° 58′
,, 24 ..	18° 49′E	7° 1′	274° 53′
,, 29 ..	20° 16′E	7° 9′	208° 49′

THE MOON:—

Date.	Phases.	H. M.
Aug. 1 ..	☾ Last Quarter	2 26 a.m.
,, 9 ..	● New Moon	6 36 a.m.
,, 16 ..	☽ First Quarter	9 6 p.m.
,, 23 ..	○ Full Moon	0 15 p.m.
,, 30 ..	☾ Last Quarter	5 28 p.m.
,, 6 ..	Apogee	4 36 a.m.
,, 21 ..	Perigee	6 48 p.m.

OCCULTATIONS.—There are no naked eye stars occulted during the month before midnight and visible from Greenwich.

THE PLANETS.—Mercury (Aug. 1, R.A. $7^h\ 52^m$; Dec. N. 16° 40′. Aug. 31, R.A. $10^h\ 12^m$; Dec. N. 12° 58′) is a morning star in Cancer and Leo; on the 13th the planet attains a greatest westerly elongation of 18° 50′. This elongation is a favourable one, the planet rising about 3.10 a.m. from the 8th to the 18th.

Venus (Aug. 1, R.A. $7^h\ 52^m$; Dec. N. 21° 31′. Aug. 31, R.A. $10^h\ 22^m$; Dec. N. 11° 40′) is a morning star in Cancer and Leo, rising at 3.54 a.m. on the 15th, or 50 minutes before the Sun. The apparent diameter of the planet is 10″, and ·99 of the disc is illuminated.

Mars (Aug. 1, R.A. $18^h\ 34^m$; Dec. S. 28° 53′. Aug. 31, R.A. $18^h\ 47^m$; Dec. S. 27° 44′) is a conspicuous object in the evening sky, being due South at 9 p.m. on the 15th. Any clear evening the planet may be observed, looking Southwards, shining as a bright reddish star not very high above the horizon. Near the middle of the month the apparent diameter of the planet is 20″. With small telescopes the Polar Cap, with its dark border, can be fairly well seen, as also other dusky markings on the disc; but the discernment of much detail must be left to observers with large telescopes. The South Polar Cap is presented to our vision as shown in the preceding diagram.

Appearance of Mars in 1907.

Jupiter (Aug. 15, R.A. $8^h\ 6^m$; Dec. N. 20° 36′) is a morning star in Cancer rising at 2.38 a.m. on the 15th. The planet is in conjunction with Venus on the 1st.

Saturn (Aug. 1, R.A. $23^h\ 53^m$; Dec. S. 3° 18′. Aug. 31, R.A. $23^h\ 47^m$; Dec. S. 4° 3′) is situated in Pisces, and rises about 8.30 p.m. near the middle of the month. The planet may be seen in S.E. portion of the sky, visible to the naked eye as a moderately bright star. The apparent diameter, and hence brightness, of the planet is increasing as opposition, which takes place next month, approaches. On the 15th the Polar diameter is 17″·6. The ring appears practically closed as seen in the telescope, the elevation of the Earth above the plane of the ring being only 1°.

Uranus (Aug. 15, R.A. $18^h\ 40^m$; Dec. S. 23° 30′), though somewhat low down in the sky, is well placed for observation during the early evening, the planet being due South on the 15th at 9.7 p.m. He is situated a little to the S.W. of the star ν^2 Sagittarii, and about 5° North of the planet Mars. Uranus is just perceptible to the naked eye, but can easily be seen with a pair of opera glasses. The diameter of the disc is nearly 4″, and the colour is greenish. As seen in large telescopes the planet appears more luminous at the centre of the disc than at the limb—somewhat similar to Jupiter and Saturn.

Neptune (Aug. 15, R.A. $7^h\ 0^m$; Dec. N. 21° 55′) does not rise until after midnight. He is situated about 1° North of the star ζ Geminorum.

METEORS:—

Date.	Radiant. R.A.	Radiant. Dec.	——
Aug. 10-12 ..	45°	N. 57°	Great *Perseid* shower; radiant moving E.N.E. about 1° per day.
,, 21-25 ..	291°	N. 60°	δ Draconids; bright slow meteors.

Minima of Algol occur on the 21st at 0.43 a.m. and the 23rd at 9.32 p.m.

TELESCOPIC OBJECTS:—

DOUBLE STARS.—Polaris, mags. 2·1, 9·5; separation 18″·6. The visibility of the small star is used as a test for a good 2-inch object glass.

σ Scorpii, R.A. $16^h\ 15^m$; S. 25° 21′; mags. 3·0, 7·6; separation 20″·6.

ζ Sagittae, R.A. $19^h\ 45^m$; N. 18° 54′; mags. 5·7, 8·8; separation 9″·0; colours, white and blue.

α^1, α^2 Capricorni, R.A. $20^h\ 13^m$; S. 12° 50′; mags. α^1 4·5, α^2 3·8; naked eye double; separation 373″; very easy with opera glasses.

γ Delphini, R.A. $20^h\ 42^m$; N. 15° 46′; mags. 4·1, 5·0; separation 10″·8; very pretty double for small telescopes; colours, orange and light green.

NEBULA, &c.—Dumb Bell nebula in Vulpecula, nearly 4° due North of γ Sagittae. Rather faint object in a 3-inch telescope.

(M8) Cluster in Sagittarius; large luminous field of small stars; fine object in a pair of field glasses. About a degree E. of the star 4 Sagittarii.